ISSN-0085-0683

MEMOIRS OF THE HOURGLASS CRUISES

Published by
Florida Department of Natural Resources
Bureau of Marine Research
St. Petersburg, Florida

VOLUME VII DECEMBER 1984 PART II

SYNALPHEUS SHRIMPS (CRUSTACEA: DECAPODA: ALPHEIDAE). I. THE GAMBARELLOIDES GROUP, WITH A DESCRIPTION OF A NEW SPECIES[1]

LIBRARY
MAR 18 1985
National Marine Fisheries Service

By

MICHAEL R. DARDEAU[2]

ABSTRACT

Distributional data and references to each of the 19 Gambarelloides species of *Synalpheus* from the Western Atlantic Region are summarized in individual species accounts. The 11 species known from the Gulf of Mexico, including a new species from the Florida Middle Ground described herein, are diagnosed and illustrated. *Synalpheus bousfieldi* and *S. herricki* are resurrected from the synonymy of *S. brooksi*, and *S. pandionis* is resurrected from the synonymy of *S. longicarpus*. *Synalpheus herricki* is redescribed, and *S. tanneri* placed in its synonymy. *Synalpheus osburni* is placed in the synonymy of *S. goodei*. A key to all *Synalpheus* known from the Western Atlantic Region is provided. Male/female ratios of most Gambarelloides species approached unity, and virtually all adult females were ovigerous. Seasonal influence on reproduction seemed to be negligible. Recruitment of juveniles occurred year-round. Immature individuals of at least six Gambarelloides species carried infertile eggs. Many species were found in male-female pairs associated to varying degrees with living substrates. Sponges were frequent hosts, and complex cryptofaunal communities of up to five *Synalpheus* species were not uncommon. Population abundances of all Gambarelloides species were greatest beyond the 37 m isobath on the central west Florida continental shelf. Species of the Gambarelloides group of *Synalpheus* lend a tropical complexion to benthic communities within the Gulf of Mexico. There seem to be no clear cut faunal barriers to this group within the northern portion of the Western Atlantic Region.

[1]MESC Contribution No. 048.

[2]Address: Dauphin Island Sea Lab, P.O. Box 369-370, Dauphin Island, AL 36528.

This public document was promulgated at an annual cost of $9163 or $9.16 per copy to provide the scientific data necessary to preserve, manage, and protect Florida's marine resources and to increase public awareness of the detailed information needed to wisely govern our marine environment.

INTRODUCTION

The genus *Synalpheus* Bate, 1888, is one of the most diverse and widely distributed genera of caridean shrimps in the world. Often known as snapping shrimps because of the popping sound made by the major first pereopod when the chela is closed rapidly, members of this genus are important components of coral reef and live bottom communities in all tropical and subtropical seas.

The Gambarelloides group (a well-defined, homogeneous group within the genus but lacking formal subgeneric status) contains over half the described species of *Synalpheus* in the Gulf of Mexico and Caribbean. Its many species are distinguished from each other by subtle, and often variable, characters. Accurate inventories of the Gulf fauna have been handicapped by difficulty in separating these shrimps at the specific level. Distributional data, diagnoses, and references to each of the 19 species of the group from the Western Atlantic Region are presented in this report. The 11 species known from the Gulf of Mexico are illustrated. Details of specific ecological associations, morphological variation, and life history strategies are also summarized.

HISTORICAL REVIEW

The earliest named species in the natural assemblage now recognized as the genus *Synalpheus* were originally assigned to the genus *Alpheus* Fabricius, 1798. Although Bate erected the genus *Synalpheus* in 1888, based on the absence of epipods on the thoracic appendages, use of the older genus persisted until 1899, when Coutière published a major work reviewing the systematic history and general biology of the Alpheidae. Bate (1888), himself, retained in *Alpheus* several species which later were assigned to *Synalpheus*.

Coutière (1898; 1899; 1900; 1907; 1908; 1909; 1910) began the difficult task of classifying the American *Synalpheus*, which culminated in what became the only major work on the genus in the western hemisphere for over 60 years, "The American species of snapping shrimps of the genus *Synalpheus*" (1909). In that report, based in part on collections made by the *Albatross*, *Fish Hawk*, and *Grampus*, he recognized only three of the five nominal species previously recorded from the western Atlantic and went on to describe 16 new species, as well as numerous subspecies, from the Gulf of Mexico and Caribbean.

Following Coutière's work, new species of *Synalpheus* from the Caribbean were described by Schmitt (1924a; 1933) and Armstrong (1949). Chace (1972), in the first comprehensive treatment of the genus since Coutière (1909), reported on the Smithsonian-Bredin collections in the Caribbean. He provided a key to the known species, described four new species, and proposed the synonymy of several others. Pequegnat and Heard (1979) described a new species of *Synalpheus* from the Bahama Islands and the Gulf of Mexico.

Christoffersen (1979) published a major systematic paper on alpheoid taxonomy based on collections made by the *Calypso* along the eastern coast of South America. This relatively unknown region produced no new species of *Synalpheus*, but Christoffersen proposed that several of Coutière's and Chace's taxa be synonymized and suggested that previously synonymized species be resurrected.

Faunal accounts of areas within the Western Atlantic Region by Abele (1970), Boone (1930),

Cerame-Vivas and Gray (1966), Chace (1937a; 1956a, b), Coelho and Ramos (1972), Corrêa (1972), Fausto-Filho and Sampaio Neto (1976), Felder and Chaney (1979), Gore (1981), Hay and Shore (1918), Heck (1977), Holthuis (1959), Lyons et al. (1971), Markham and McDermott (1981), McClendon (1911), Menzel (1971), Monod (1939), Pearse (1932a, b; 1950), Pearse and Williams (1951), Pequegnat and Ray (1974), Rathbun (1901), Ray (1974), Rodriguez (1980), Rouse (1970), Schmitt (1924a, b; 1930; 1935; 1936; 1939), Soto (1972), Tabb and Manning (1961), Verrill (1900; 1922), Wass (1955), Westinga and Hoetjes (1981), Williams (1965), Young (1978), and Zimmer (1913) all mention Gambarelloides species of *Synalpheus*.

ACKNOWLEDGMENTS

Although it is impossible to list all of the people who contributed to this report, I am particularly indebted to Dr. Richard Heard, Dr. Joseph Fitzpatrick, and to personnel at the Florida Department of Natural Resources Bureau of Marine Research, especially Mr. David Camp and Mr. William Lyons. Dr. Linda Pequegnat, Ms. Joan Uebelacker, and staff members of the American Museum of Natural History, the Museum of Comparative Zoology, and the National Museum of Natural History kindly provided specimens. Dr. Mary Wicksten, Ms. D. M. Banner, and Dr. F. A. Chace, Jr., generously provided valuable information and advice. Mr. Daniel Adkison and Dr. Robert Gore encouraged and assisted me in many ways. Ms. Sharon Wilson expertly typed the manuscript, and Figures 2, 15, 16, 17, 22, 31, 36, 44, 45, 46, and 54 were prepared by Ms. Linda Lutz. Partial support was provided by a fellowship from the Marine Environmental Sciences Consortium.

Special thanks are due to Dr. Thomas Hopkins (under Bureau of Land Management Contract AA 551-CT8-35) and to his dive team for financial and logistic support and for much, much more. Finally, this effort is dedicated to my wife, Dawn, whose loving support made it all possible.

MATERIALS AND METHODS

The majority of specimens for this study was collected by personnel from the Florida Department of Natural Resources during the Hourglass Cruises, 1965-1967, when monthly dredge and trawl samples were taken over a 28-month period at 10 stations offshore from Tampa Bay and Sanibel Island. Stations were located on two transects 160 km apart at depths of 6, 18, 37, 55, and 73 m (Figure 1). Exact coordinates and depths of the stations are given in Table 1. Samples were taken from the R/V *Hernan Cortez*. Complete descriptions of stations, sampling gear, methodology, and hydrographic data are presented in Joyce and Williams (1969).

Additional material was collected from the Florida Middle Ground (FMG) (Figure 2), a deep reef biotope, by a team of SCUBA divers from Dauphin Island Sea Lab. Individual coral and sponge hosts were bagged *in situ*, the bags sealed, and returned to the surface for careful removal of cryptofauna. Samples were taken from depths ranging from 26-34 m; the exact depth for a particular sample was often not available. Several stations within the reef complex were sampled (Table 2). FMG Stations 151 and 247 were sampled in October 1978, January 1979, and June-July 1979. Fall and summer samples were successfully collected at FMG Stations 481 and 491, but poor weather conditions precluded sampling at these stations during winter. Station 492 was established in July 1979 when good weather allowed additional sampling. A preliminary characterization of the biota of the Florida Middle Ground was given by Hopkins et al. (1977).

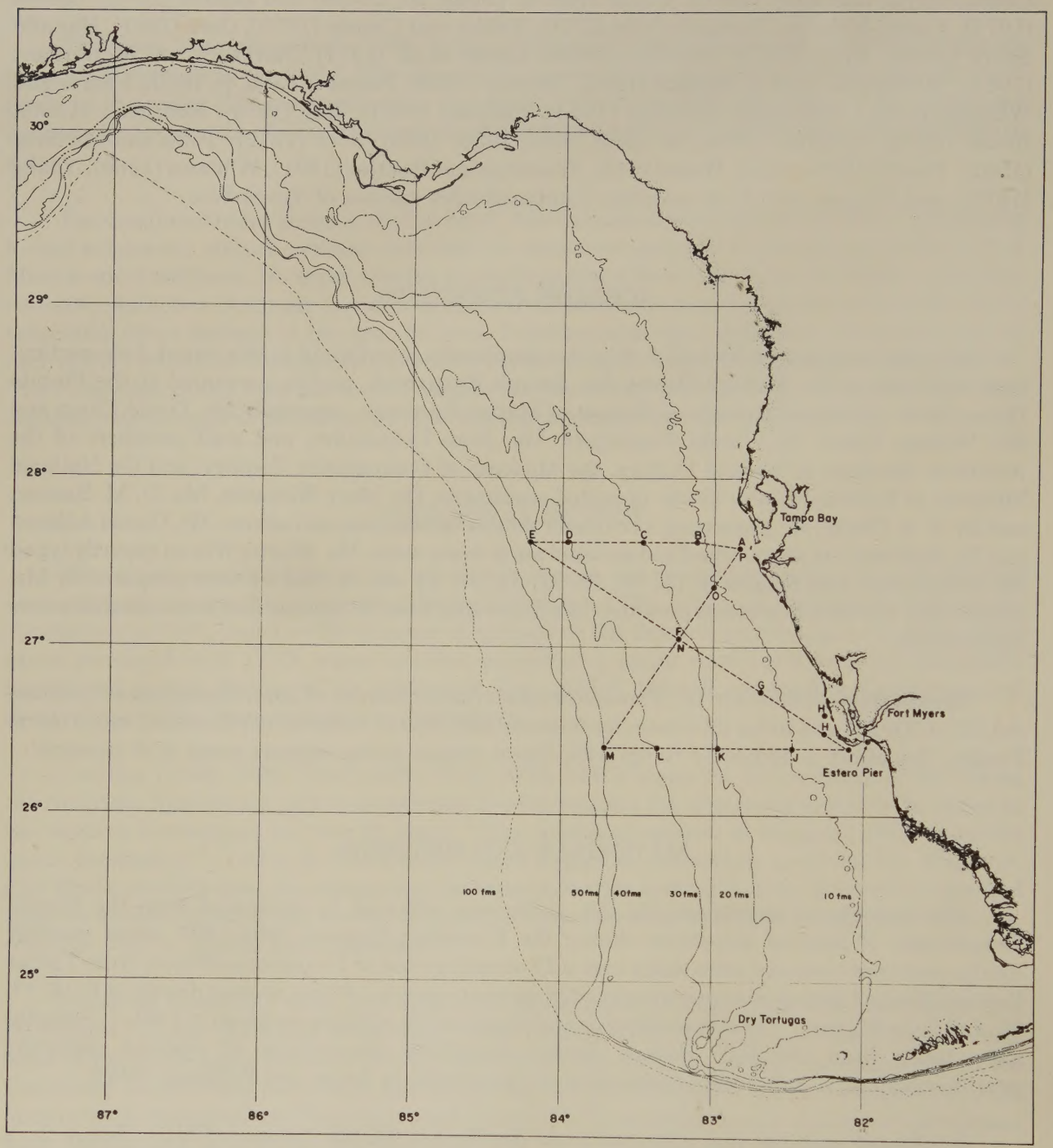

Figure 1. Hourglass cruise pattern and station locations.

TABLE 1. LOCATIONS AND DEPTHS OF BENTHIC HOURGLASS STATIONS.

Station	Latitude*	Longitude*	Established Depth (meters)	Approximate Nautical Miles Offshore*
A	27°35'N	82°50'W	6.1	4, due W of Egmont Key
B	27°37'N	83°07'W	18.3	19, due W of Egmont Key
C	27°37'N	83°28'W	36.6	38, due W of Egmont Key
D	27°37'N	83°58'W	54.9	65, due W of Egmont Key
E	27°37'N	84°13'W	73.2	78, due W of Egmont Key
I	26°24'N	82°06'W	6.1	4, due W of Sanibel Island Light
J	26°24'N	82°28'W	18.3	24, due W of Sanibel Island Light
K	26°24'N	82°58'W	36.6	51, due W of Sanibel Island Light
L	26°24'N	83°22'W	54.9	73, due W of Sanibel Island Light
M	26°24'N	83°43'W	73.2	92, due W of Sanibel Island Light

*U.S. Coast and Geodetic Chart No. 1003, dated June 1966.

Synalpheus species from the hard banks of the western Gulf of Mexico (Figure 2) were obtained from Texas A&M University. These specimens were also collected by divers, either using SCUBA or from a submersible, and records of exact depth of capture frequently were unfeasible.

A small collection made by SCUBA divers from Dauphin Island Sea Lab in the Bahama Islands in November 1975 proved crucial to the solution of several taxonomic problems. These specimens were collected by placing bags over individuals of *Agelas dispar*, a sponge, sealing them, and returning them to the surface for processing. Like previous diver-collected samples, only a range of depths where hosts were collected is available.

Finally, type material at the American Museum of Natural History and at the U.S. National Museum of Natural History was examined. In addition, many of Chace's (1972) Smithsonian-Bredin specimens, as well as other material at the U.S. National Museum of Natural History, were examined.

The relatively large collections from the eastern Gulf of Mexico (Hourglass and Florida Middle Ground) are listed by station in the *Material examined* section of each species account. Reference to Tables 1 and 2 will be necessary for exact coordinates and, in the case of the Hourglass samples, depths. The remaining, smaller, supplementary collections are listed as OTHER MATERIAL, and all available data are included with the accounts. Within each station, specimens are listed in chronological order of capture, then by gear used. Specimen data include number of specimens by sex, range of sizes, reproductive state, host (if available), and deposition of specimens.

Specimens are deposited in invertebrate collections at the U.S. National Museum of Natural History, Washington, D.C. (USNM); the American Museum of Natural History, New York, New York (AMNH); the Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts (MCZ); Florida Department of Natural Resources Bureau of Marine Research, St. Petersburg, Florida (FSBC I); Texas A&M University, College Station, Texas (TAMU); and the Marine Environmental Sciences Consortium, Dauphin Island, Alabama (MESC).

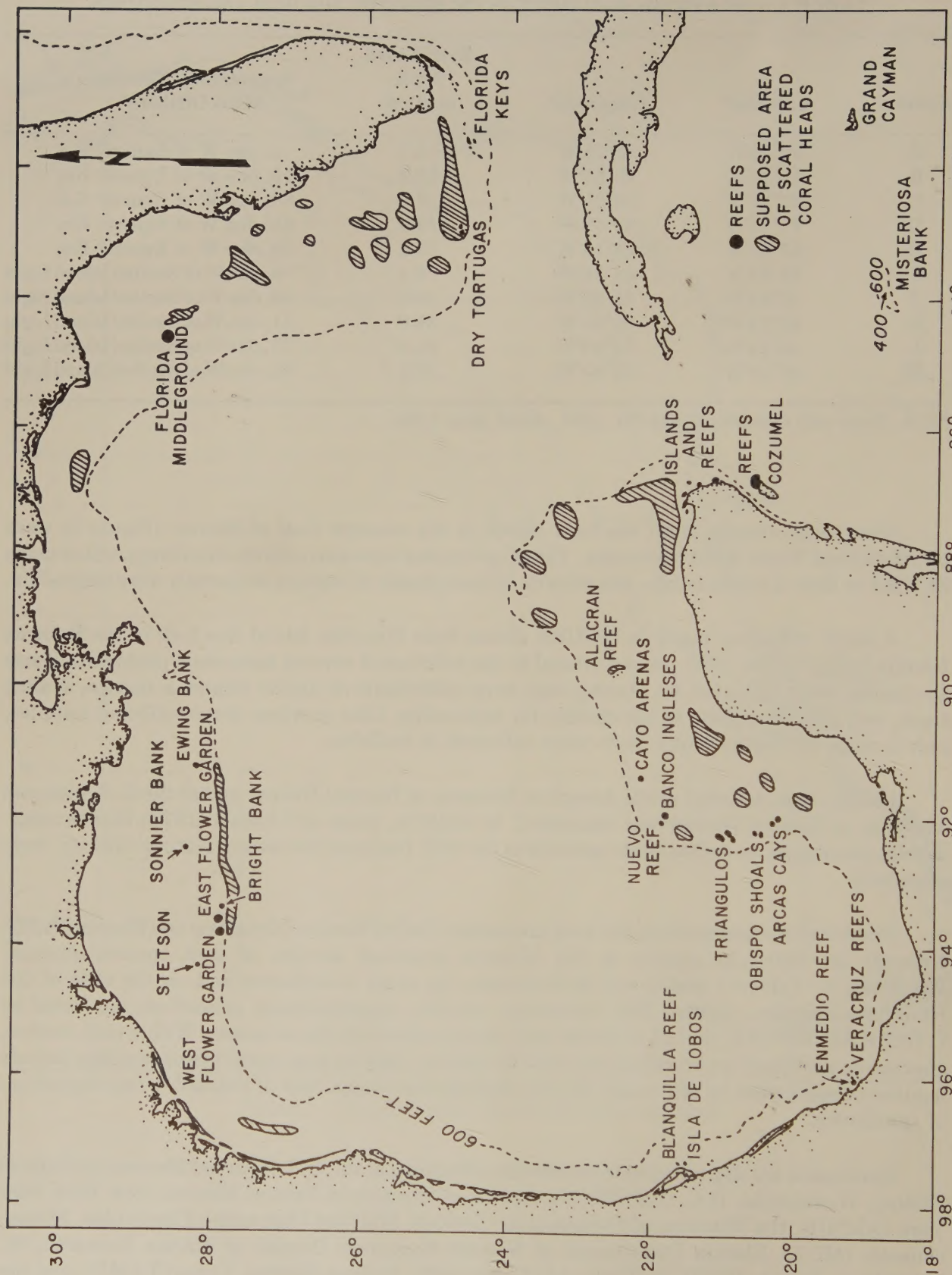

Figure 2. Gulf of Mexico, showing locations of known coral reefs [after Bright and Pequegnat (1974)].

TABLE 2. LOCATIONS OF FLORIDA MIDDLE GROUND (FMG) STATIONS.

Station	Latitude	Longitude
151	28°32'N	84°19'W
247	28°36'N	84°16'W
481	28°31'N	84°19'W
491	28°27'N	84°17'W
492	28°27'N	84°18'W

Specimens were measured to the nearest 0.1 mm using an ocular reticle calibrated to a stage micrometer. Measurements were:
(1) Carapace length (CL), measured from the level of the posterior margin of the ocular sinuses to the posterior margin of the carapace.
(2) Carpus length, measured along the extensor margin of the carpus of the minor first pereopod, from the junction of the merus to the propodal junction.
(3) Chela length, measured along the greatest length of the chela (propodus plus dactyl) of the minor first pereopod from the junction of the carpus to the tip of the fingers.
The carpus:chela ratio serves to separate several species; measurements must be made carefully.

Determinations of postlarval developmental stages and of the gender of less than fully mature *Synalpheus* are difficult (see Reproduction, pp. 106-108). Relative age was determined by measuring a large series of specimens and carefully considering demographic representation. Small male-form specimens bearing infertile eggs are referred to simply as females except when present in sufficient numbers to reliably distinguish a size range. If infertile eggs are carried by the size class between mature adults and juveniles, the size class is referred to as subadult. If the size class contains specimens with male secondary sex characters but bearing fertile eggs, however, those specimens are termed adolescent. Like subadults, adolescents are smaller than mature adults but larger than juveniles. In both cases, specimens with eggs (either fertile or infertile) are used to delineate the size class, but all specimens in that range, regardless of reproductive condition, are considered to be subadult or adolescent. If infertile eggs are present on specimens smaller than adolescents, those specimens are referred to as juveniles.

Synalpheus shrimps were frequently infected with parasitic isopods, both by branchial forms, referred to herein as "with bopyrid", and by abdominal forms, referred to as "with hemiarthrine". In most cases, branchial parasites were not actually present, having been lost in the sorting process. The shrimps were listed as being infected because of the characteristic modification of the branchial chamber.

Several morphological structures, especially important in alpheid systematics, may not be familiar and therefore are defined below (after McLaughlin, 1980):

STYLOCERITE—rounded or spiniform process on outer part of proximal article of antennular peduncle.

BASICERITE—second article of antennal peduncle, bearing scaphocerite; produced laterally into long spine in *Synalpheus*.

SCAPHOCERITE—exopod of antenna, including both lamellar and spine portions.

CARPOCERITE—distal article of antennal peduncle.

All drawings were made with the aid of a camera lucida.

SYSTEMATICS

Coutière (1909) divided the genus *Synalpheus* into six groups, which he called the Comatularum, Neomeris, Paulsoni, Brevicarpus, Laevimanus, and Biunguiculatus groups, based upon member species. In the past, the groups functioned as subgenera but were never accorded formal nomenclatural status. Holthuis and Gottlieb (1958) demonstrated *Synalpheus laevimanus* (Heller, 1862) to be a junior synonym of *S. gambarelloides* (Nardo, 1847), so Coutière's Laevimanus group has subsequently been called the Gambarelloides group. Banner and Banner (1975) recently reviewed Coutière's groups and concluded that only the Comatularum, Brevicarpus, and Gambarelloides groups were taxonomically useful.

The Gambarelloides group is characterized by a dense fringe of curved hairs on the extensor surface of the dactyl of the minor chela. Its members are found principally in the warm waters of the Gulf of Mexico and Caribbean, usually associated, often commensally, with a variety of coral reef organisms. In addition to the 19 species treated below, four other Gambarelloides *Synalpheus* are recognized. *Synalpheus parfaiti* Coutière, 1898, occurs off the West African coast and *S. gambarelloides* (Nardo, 1847), from which the group takes its name, is distributed throughout the Mediterranean Sea. *Synalpheus sladeni* Coutière, 1908, is known only from the Indo-Pacific region and the Gulf of Aqaba. A fourth extra-American species, *S. spongicola* Banner and Banner, 1981, has been recently described from the Red Sea. The presence of the group in the Gulf of California is indicated by the description of a subspecies, *Synalpheus goodei occidentalis* Coutière, 1909, from the region, but there has been no published reference since, and its current status is uncertain. The specimens from lower California reported by Chace (1937b) as *S. herricki* Coutière, 1909, represent an undescribed species in the Gambarelloides group.

Throughout this study, I have been inclined to accept a rather wide range of variation as normal. For example, specimens of *Synalpheus bousfieldi* Chace, 1972, from the Gulf of Mexico clearly differ from those from the Bahamas, and both populations differ from Chace's (1972) Caribbean type material. Specimens of *S. paraneptunus* Coutière, 1909, from the Gulf likewise differ from Caribbean conspecifics. Because of the great number of described species and the widespread morphological variation exhibited by individuals, I feel that a procrustean approach best serves the needs of current *Synalpheus* systematics. Variants have been illustrated and compared with the typical form without recourse to the creation of further new species. This material should be given specific status only if warranted by further study.

The large number of species, the inherent variability, and the subtle distinctions between species make construction of a reliable key difficult. The following key has been substantially modified from that of Chace (1972), but his caution concerning its inefficacy for juveniles, single specimens, and small lots still applies. The separation of several species complexes on the basis of the dorsal telson spination is perhaps no better than the utilization of relative lengths of the lateral spines of the basicerite and scaphocerite by Chace (1972), but it offers an alternative in the many cases where variation in the length of these structures may obscure specific differences. In the same way, his key may prove more useful when positions of the dorsal telson spines are ambiguous. In identifying specimens of *Synalpheus* there is no substitute for a large series of specimens, detailed ecological data, and experience.

KEY TO *SYNALPHEUS* OF THE GULF OF MEXICO AND ADJACENT WATERS
(adapted from Chace, 1972)

1. Stylocerite not overreaching basal segment of antennular peduncle (except in *S. macclendoni* and *S. paraneptunus*); dactyl of minor chela with prominent fringe of long, distally curved hairs on extensor surface (reduced to a longitudinal row in *S. paraneptunus*) ..... (Gambarelloides group) 2

1. Stylocerite distinctly overreaching basal segment of antennular peduncle; dactyl of minor chela with scattered tufts of straight hairs but without prominent fringe on extensor surface. (Scaphocerite with well-developed blade, lateral spine considerably exceeding that of basicerite) 20

2. Both pairs of dorsal spines of telson arising in posterior 1/2 of segment. (Ocular hoods blunt, broader than long) ..... *Synalpheus heardi* n. sp.

2. Anterior or both pairs of dorsal spines of telson arising in anterior 1/2 of segment 3

3. Both pairs of dorsal spines of telson arising in anterior 1/2 of segment. (Carapace not distinctly produced at anteroventral angle; cardiac notch not well marked; basicerite not produced dorsally; palm of major chela armed with sharp distal spine) 4

3. Posterior pair of dorsal spines of telson arising in posterior 1/2 of segment..... 5

4. Carapace carinate anteriorly in dorsal midline; ocular hoods blunt, longer than broad but distinctly broader than rostrum; scaphocerite with vestige of blade; dactyl of minor chela subequally bidentate distally; fixed finger of major chela not reduced ..... *S. anasimus* Chace, 1972

4. Carapace not carinate in dorsal midline posterior to base of rostrum; ocular hoods acute, as broad as long but not much broader than rostrum; scaphocerite without vestige of blade; dactyl of minor chela strongly tridentate in lateral view; fixed finger of major chela reduced, not reaching nearly as far distally as does movable finger..... *S. pectiniger* Coutière, 1907

5. Anterior or both pairs of dorsal spines of telson arising directly from, or nearly from, lateral margins of telson. (Lateral branch of uropod with only 1 fixed tooth on lateral margin proximal to movable spine; anterior margin of telson subequal in length to lateral margin)..... 6

5. Both pairs of dorsal spines of telson distinctly removed from lateral margins of telson... 7

6. Both pairs of dorsal spines of telson arising directly from lateral margin; lateral spine of basicerite falling considerably short of scaphocerite ..... *S. brevifrons* Chace, 1972

6. Anterior pair of dorsal spines of telson arising from very near lateral margin; lateral spine of basicerite reaching nearly to or beyond scaphocerite ..... *S. bousfieldi* Chace, 1972

7. Carpus of pereopod 2 composed of 4 articles..... 8

7. Carpus of pereopod 2 composed of 5 articles..... 11

8. Basicerite with strong dorsal spine 9

8. Basicerite unarmed dorsally 10

9. Fingers of chela of pereopod 2 filiform; major chela with distal palmar tubercle secondarily armed with small, sharp anteroventral tooth ..... *S. filidigitus* Armstrong, 1949

9. Fingers of chela of pereopod 2 not filiform; major chela with distal palmar tubercle unarmed ..... *S. rathbunae* Coutière, 1909

10. Maxilliped 3 with cluster of setae on tip of distal segment; lateral spine of basicerite nearly equal in length to that of scaphocerite ..... *S. barahonensis* Armstrong, 1949

10. Maxilliped 3 with circlet of 8 to 10 spines on tip of distal segment; lateral spine of basicerite considerably shorter than that of scaphocerite..... *S. agelas* Pequegnat and Heard, 1979

11. Lateral branch of uropod with 1 fixed tooth on lateral margin, sometimes at distolateral angle just lateral to movable spine, sometimes distinctly removed from distolateral angle. (Basicerite not produced dorsally) 12

11. Lateral branch of uropod with 2 or more fixed teeth on lateral margin proximal to distolateral angle 16

12. Scaphocerite with well-developed blade. (Fingers of minor chela not bidentate distally) 13

12. Scaphocerite without blade 14

13. Ocular hoods slender, not much broader than rostrum; stylocerite slightly overreaching basal antennular segment; major chela not noticeably twisted.... *S. macclendoni* Coutière, 1910

13. Ocular hoods stout, distinctly broader than rostrum; stylocerite not reaching as far as end of basal antennular segment; major chela twisted ..... *S. sanctithomae* Coutière, 1909

14. Pereopod 3 with abruptly compressed flanges on flexor margins of merus and carpus; fingers of minor chela not bidentate..... *S. androsi* Coutière, 1909

14. Pereopod 3 without flanges on merus and carpus; fingers of minor chela subequally bidentate 15

15. Carpus of minor first pereopod 1/2 as long as chela; pleuron of third abdominal somite of male subrectangular ventrally; stylocerite broad, usually reaching about to midpoint of first antennular segment; lateral margins of telson usually straight in posterior 1/4..... ..... *S. brooksi* Coutière, 1909

15. Carpus of minor first pereopod 3/4 as long as chela; pleuron of third abdominal somite of male W-shaped ventrally; stylocerite slender, usually reaching to distal 1/4 of first antennular segment; lateral margins of telson usually concave in posterior 1/4..... *S. herricki* Coutière, 1909

16. Lateral spine of basicerite reaching nearly to or beyond tip of scaphocerite; ventral rostral projection strongly produced posteriorly, juxtaposed with ocular bossae..... ..... *S. pandionis* Coutière, 1909

16. Lateral spine of basicerite falling considerably short of tip of scaphocerite; ventral rostral projection weakly produced posteriorly, not juxtaposed with ocular bossae 17

17. Opposing surfaces of fingers of minor chela excavate, brush of hairs on dactyl reduced; lateral branch of uropod armed with 1 to 4, usually 2, teeth proximal to movable spine. (Dactyl of minor chela broadly tridentate distally in extensor aspect) .... *S. paraneptunus* Coutière, 1909

17. Opposing surfaces of fingers of minor chela not excavate, brush of hairs on dactyl well developed; lateral branch of uropod armed with 4 to 10 teeth proximal to movable spine..... 18

18. Basicerite acute dorsally ..... *S. goodei* Coutière, 1909

18. Basicerite rounded or obtuse dorsally 19

19. Dactyl of major chela far overreaching very short fixed finger ..... *S. disparodigitus* Armstrong, 1949

19. Dactyl of major chela barely overreaching fixed finger ..... *S. longicarpus* (Herrick, 1891)

20. Ocular hoods triangular, not much broader than rostrum 21

20. Ocular hoods elongate, much broader than rostrum 24

21. Rostrum with well-developed ventral process preventing corneas of eyes from touching; palm of major chela unarmed distally; merus of pereopod 3 short and broad, less than 2 1/2 times as long as broad ..... *S. curacaoensis* Schmitt, 1924

21. Ventral process of rostrum vestigial or lacking, not preventing corneas of eyes from touching; palm of major chela with distal tooth or spine; merus of pereopod 3 about 4 times as long as broad 22

22. Ocular hoods broadly obtuse; stylocerite broadly rounded distally; basicerite not produced dorsally ..... *S. obtusifrons* Chace, 1972

22. Ocular hoods acute; stylocerite tapering to slender tip; basicerite with acute or subacute projection dorsally 23

23. Lateral surface of palm of major chela with 2 broad and sinuous lateral lobes, in addition to sharp dorsal tooth ..... *S. minus* (Say, 1818)

23. Lateral surface of palm of major chela with narrow, prominent, unarmed projection between dorsal tooth and 2 broad lateral lobes ..... *S. brevicarpus* (Herrick, 1891)

24. Dactyls of 3 posterior pairs of pereopods with distal tooth on flexor margin distinctly divergent from axis of segment and much broader than extensor tooth, flexor margin with prominence proximal to distal tooth. (Basicerite strongly spinous dorsally) 25

24. Dactyls of 3 posterior pairs of pereopods with terminal teeth subparallel, no prominence on flexor margin proximal to distal tooth 26

25. Proximal prominence on flexor margin of dactyls of 3 posterior pairs of pereopods small and obtuse ..... *S. fritzmuelleri* Coutière, 1909

25. Proximal prominence on flexor margin of dactyls of 3 posterior pairs of pereopods large and sharp ..... *S. hemphilli* Coutière, 1908

26. Basicerite unarmed dorsally 27

26. Basicerite armed dorsally with strong spine 28

27. Ventral rostral process very strongly produced, with cavity posteroventrally to accept ocular beak; distal spine on palm of major chela absent ..... *S. scaphoceris* Coutière, 1910

27. Ventral rostral process not strongly produced, evenly convex posteroventrally; strong spine on palm of major chela ..... *S. townsendi* Coutière, 1909

28. Palm of major chela unarmed distally ..... *S. tenuispina* Coutière, 1909

28. Palm of major chela armed distally with curved spine 29

29. Merus of pereopod 3 unarmed; dactyls of 3 posterior pairs of pereopods with distal tooth on flexor margin narrower than extensor tooth ..... *S. apioceros* Coutière, 1909

29. Merus of pereopod 3 armed on distal half of flexor margin with series of movable spines; dactyls of 3 posterior pairs of pereopods with distal tooth on flexor margin broader than extensor tooth ..... *S. dominicensis* Armstrong, 1949

Synalpheus agelas Pequegnat and Heard, 1979

Figures 3-6

Synalpheus sp. (near S. *rathbunae* Coutière, 1909): Pequegnat and Ray, 1974, p. 250, figs. 58, 59; Ray, 1974, pp. 163-170, figs. 150-161. [Not *Synalpheus rathbunae* Coutière, 1909].

Synalpheus agelas Pequegnat and Heard, 1979, pp. 110-116, figs. 1-4.

Material examined: HOURGLASS STATIONS: None. — FMG STATION 151: 2 ♂, 4.9, 5.0; 1 ovig. ♀, 5.8; 1 ♀ (with infertile eggs), 4.5; 2 juv., 2.3, 2.5; 27-30 m; 3 October 1978; *Agelas dispar*; USNM 189145. — 6 ♂, 4.5-5.4; 6 ovig. ♀, 5.4-6.2; 2 ♀, 4.6, 4.7; 5 juv., 2.6-3.8; 26-27 m; 5 October 1978; *Agelas dispar*; MESC 6179-2102. — 2 ♂, 4.5, 5.0; 2 ovig. ♀, 5.7, 5.9; 1 juv., 2.0; 26 m; 17 January 1979; *Agelas dispar*; MESC 6179-2103. — 4 ♂, 4.7-5.3; 1 ovig. ♀, 5.6; 2 ♀, 4.3, 4.6; 14 juv., 1.2-2.3; 26 m; 17 January 1979; *Agelas dispar*; MESC 6179-2104. — 1 ♂, 4.8; 1 ovig. ♀, 5.0; 15 juv., 2.2-3.5; 32 m; 28 June 1979; *Agelas dispar*; MESC 6179-2105. — 7 ♂, 4.6-5.3; 7 ovig. ♀, 5.3-6.0; 8 juv., 2.6-3.8; 32 m; 28 June 1979; *Agelas dispar*; MESC 6179-2106. — FMG STATION 247: 3 ♂, 4.0-5.2; 2 ovig. ♀, 5.8, 6.3; 6 ♀, 3.6-5.9 (2 with infertile eggs, 3.6, 3.8); 1 juv., 2.3; 27-30 m; 12 October 1978; *Agelas dispar*; USNM 189146. — 1 ♂, 5.3; 1 ovig. ♀, 6.4; 27-30 m; 12 October 1978; *Agelas dispar*; USNM 189147. — 1 ♂, 4.5; 1 ovig. ♀, 5.6; 1 juv., 3.8; 26-30 m; 30 January 1979; *Agelas dispar*; MESC 6179-2107. — 1 ♂, 5.0; 1 ovig. ♀, 5.3; 1 juv., 1.5; 29-30 m; 30 January 1979; *Agelas dispar*; MESC 6179-2108. — 6 ♂, 4.7-5.3; 9 ovig. ♀, 5.4-6.2; 3 ♀, 5.1-5.2; 2 juv., 2.1, 3.6; 30 m; 24 June 1979; *Agelas dispar*; MESC 6179-2109. — 2 ♂, 4.3, 4.8; 2 ovig. ♀, 5.3, 5.5; 1 juv., 2.3; 27-29 m; 21 June 1979; *Agelas dispar*; MESC 6179-2110. — FMG STATION 481: 9 ♂, 4.1-5.1; 6 ovig. ♀, 4.9-6.2; 2 ♀, 5.3, 5.6; 4 juv., 2.2-3.8; 27-29 m; 6 October 1978; *Agelas dispar*; MESC 6179-2111. — 5 ♂, 3.9-5.6; 2 ovig. ♀, 4.7, 5.1; 10 juv., 1.8-3.8; 27-29 m; 6 October 1978; *Agelas dispar*; MESC 6179-2112. — 5 ♂, 4.5-5.2; 5 ovig. ♀, 5.2-5.8; 3 juv., 2.0-2.5; 30-34 m; 8 July 1979; *Agelas dispar*; MESC 6179-2113. — 1 ♂, 4.5; 1 ovig. ♀, 5.3; 4 juv., 1.7-3.2; 30-34 m; 8 July 1979; *Agelas dispar*; MESC 6179-2114. — FMG STATION 491: 2 ♂, 4.2, 4.3; 2 ovig. ♀, 4.5, 5.3; 3 juv., 2.2-2.7; 29 m; 16 October 1978; *Agelas dispar*; MESC 6179-2115. — 3 ♂, 4.5-4.9; 3 ovig. ♀, 4.4-5.7; 3 juv., 1.9-2.4; 30 m; 4 July 1979; *Agelas dispar*; MESC 6179-2116. — 3 ♂, 4.2-5.2; 2 ovig. ♀, 5.3, 5.8; 2 ♀ (with infertile eggs), 4.2, 4.3; 14 juv., 1.0-3.8; 30 m; 4 July 1979; *Agelas dispar*; MESC 6179-2117. — OTHER MATERIAL: 1 ♂, 5.1; 1 ovig. ♀, 6.3; West Flower Garden Bank; 27°52'N, 93°48'W; 25 m; 8 October 1971; T. J. Bright (coll.); PARATYPES; TAMU 2-6250. — 3 juv., 1.7-2.6; Sonnier Bank; 28°20'N, 92°27'W; 25-60 m; 27 September 1977; submersible; TAMU 2-6242. — 6 ♂, 3.2-3.6; 5 ovig. ♀, 3.6-4.1; 2 juv., 2.1, 2.3; Freeport, Grand Bahama Island; 21-23 m; November 1975; diver-collected; *Agelas dispar*; MESC 6179-2118. — 6 juv., 2.4-2.7; Freeport, Grand Bahama Island; 21-23 m; November 1975; diver-collected; *Agelas dispar*; MESC 6179-2119. — 1 ♂, 4.0; 2 ovig. ♀, 3.7, 4.2; 1 ♀, 4.4; 4 juv., 1.6-1.9; Freeport, Grand Bahama Island; 21-23 m; November 1975; diver-collected; *Agelas dispar*; MESC 6179-2120. — 1 ♀, 5.2; west of Puerto Rico; 18°14'N, 67°25'W; 36-73 m; 13 February 1933; Johnson Smithsonian Deep-Sea Expedition Station 45; tangles; USNM 191019.

Diagnosis: Rostrum and ocular hoods variable; rostrum (Figures 3b, 4a) usually triangular, subequal in length to ocular hoods, convex ventrally. Pleuron of first abdominal somite of male (Figure 3d) bearing hooked tooth posteriorly, that of second broadly rounded, those of third, fourth, and fifth subrectangular, that of sixth acuminate. Telson (Figures 3c, 4c) broad anteriorly, narrower posteriorly, with lateral margins sometimes concave in posterior 1/4; anterior pair of dorsal spines arising just anterior to midlength of segment, posterior pair situated about midway between anterior pair and posterior margin. Stylocerite (Figures 3b, 4a) extending nearly to distal margin of first segment of antennular peduncle. Scaphocerite considerably exceeding lateral spine of basicerite, blade reduced; basicerite not armed dorsally. Distal tip of maxilliped 3 (Figures 3a, 5a) armed conspicuously with circlet of spines. Palm of major chela (Figure 3e-g) swollen, terminating distodorsally in single stout spine. Dactyl of minor chela (Figure 4f) shallowly bidentate distally, tips arranged perpendicular to plane of chela, dense fringe of curved hairs present on extensor surface; fixed finger shallowly bidentate, tips arranged in plane of finger; length of carpus about 1/2 that of chela. Carpus of pereopod 2 (Figure 5h) composed of 4 articles. Dactyls of posterior 3 pereopods (Figure 5j, l, n) with proximal tooth stronger than and slightly divergent from distal tooth. Lateral branch of uropod (Figures 3c, 4c) usually with single tooth proximal to movable spine.

Variation: The rostrum is sometimes reduced to about half the length of the ocular hoods or, more rarely, is entirely absent. The ocular hoods are often broader than in Figure 3b, with the lateral margins convex and the tips directed mesially (Figure 4a). Length of the basicerite spine relative to the scaphocerite varies from 1/2 to nearly 4/5. The degree of sinuousity of the lateral margins of the telson may also vary. Although usually moderately convex in the posterior 1/4, they are sometimes nearly straight (Figure 4c). Variation in the dentition of the lateral margin of the uropodal exopodite has been illustrated by Pequegnat and Heard (1979). Roughly 10% of the above specimens had two, or more rarely three, teeth proximal to the movable spine.

Juveniles typically have the blade of the scaphocerite relatively well developed (Figure 6a), but it becomes more reduced with subsequent molts. The fingers of the major chela (Figure 6b) are also distinctive in juveniles; the dactyl is strongly hooked and considerably overreaches the fixed finger.

Despite the variability displayed by this species, it is easily recognized by the robust form of the major chela, the reduced number of carpal articles in pereopod 2, and, finally, by the characteristically strong circlet of spines situated distally on maxilliped 3.

Color: Based on notes taken from live material from the Florida Middle Ground: Carapace and abdomen transparent orange, speckled with dark red chromatophores dorsally on carapace and laterally on abdomen; ovaries bright orange; eggs orange with yellow yolk; telson and uropods lighter, transparent orange. Antennae and antennules transparent orange. Pereopods and maxilliped 3 transparent orange, speckled with dark red chromatophores; major and minor pereopods 1 darker orange distally; fingers of major chela tipped in clear amber.

Pequegnat and Heard (1979: 114) gave the color of West Flower Garden material as: "body tan; chelae on first pereiopods pale with orange fingers."

Size (CL in mm): Gulf of Mexico specimens: males, 3.9-5.6; ovigerous females, 4.5-6.4; females without eggs, 4.3-5.9; females with infertile eggs, 3.6-4.5; juveniles, 1.0-3.8. Bahamian specimens: males, 3.2-4.0; ovigerous females, 3.6-4.2; juveniles, 1.6-2.7.

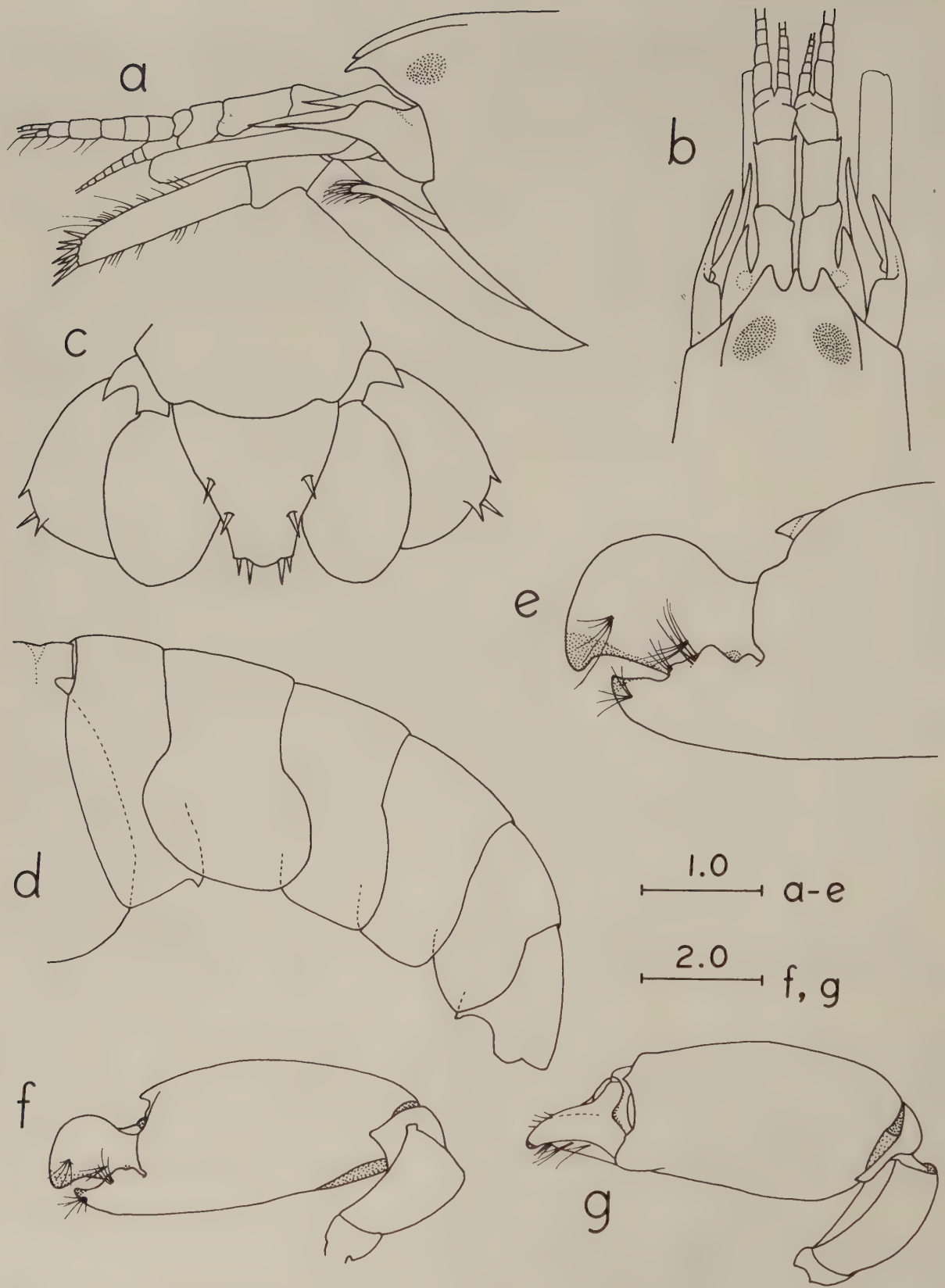

Figure 3. *Synalpheus agelas*, male, CL 5.3, USNM 189147; a. anterior region, lateral view; b. same, dorsal view; c. telson and uropods; d. abdomen; e. left major chela, lateral view of distal portion; f. same, lateral view; g. same, dorsal view.

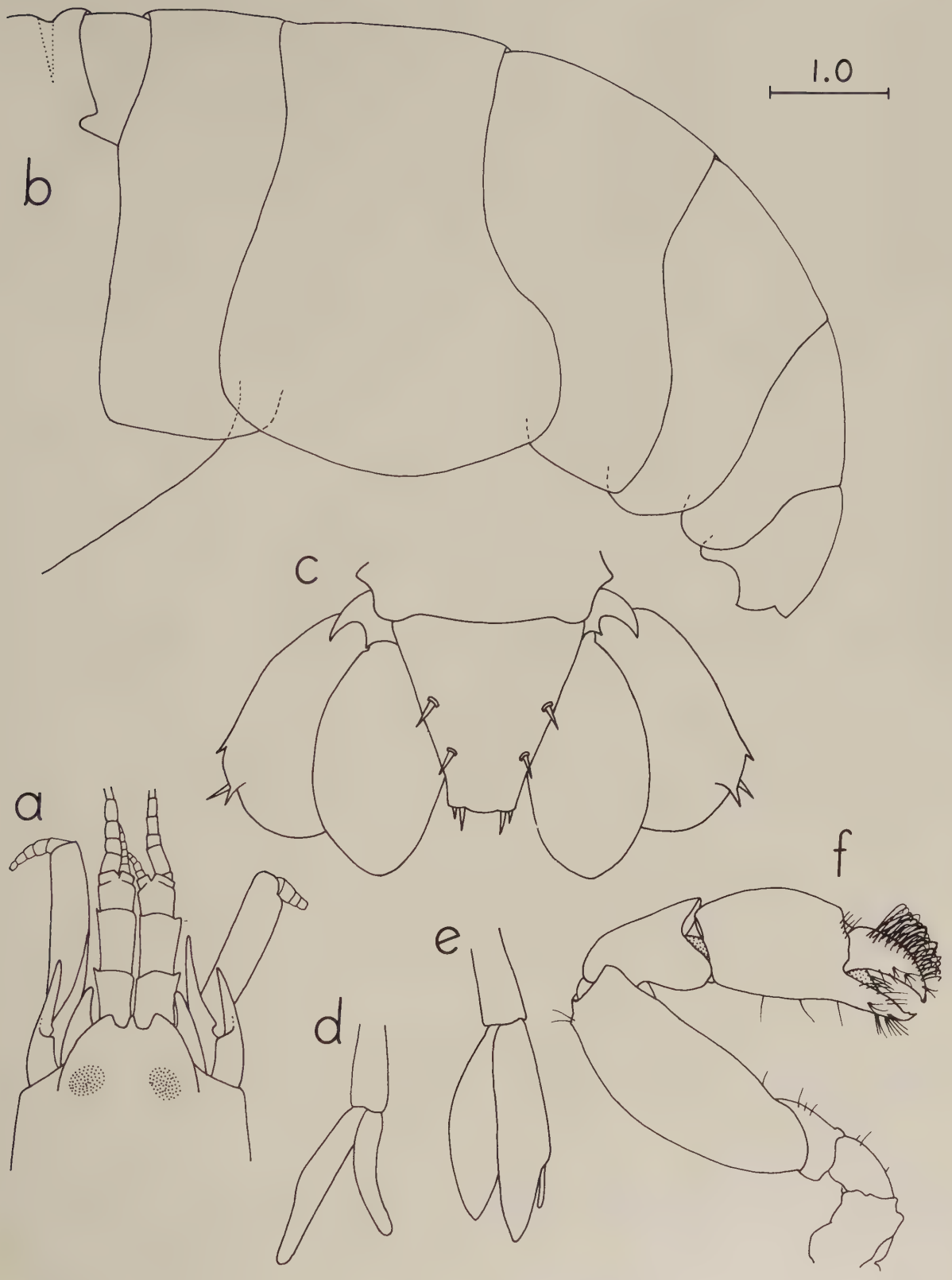

Figure 4. *Synalpheus agelas*, ovigerous female, CL 5.8, USNM 189146; a. anterior region, dorsal view. Ovigerous female, CL 6.4, USNM 189147; b. abdomen; c. telson and uropods; d. left pleopod 1; e. left pleopod 2. Male, CL 5.3, USNM 189147; f. right minor chela.

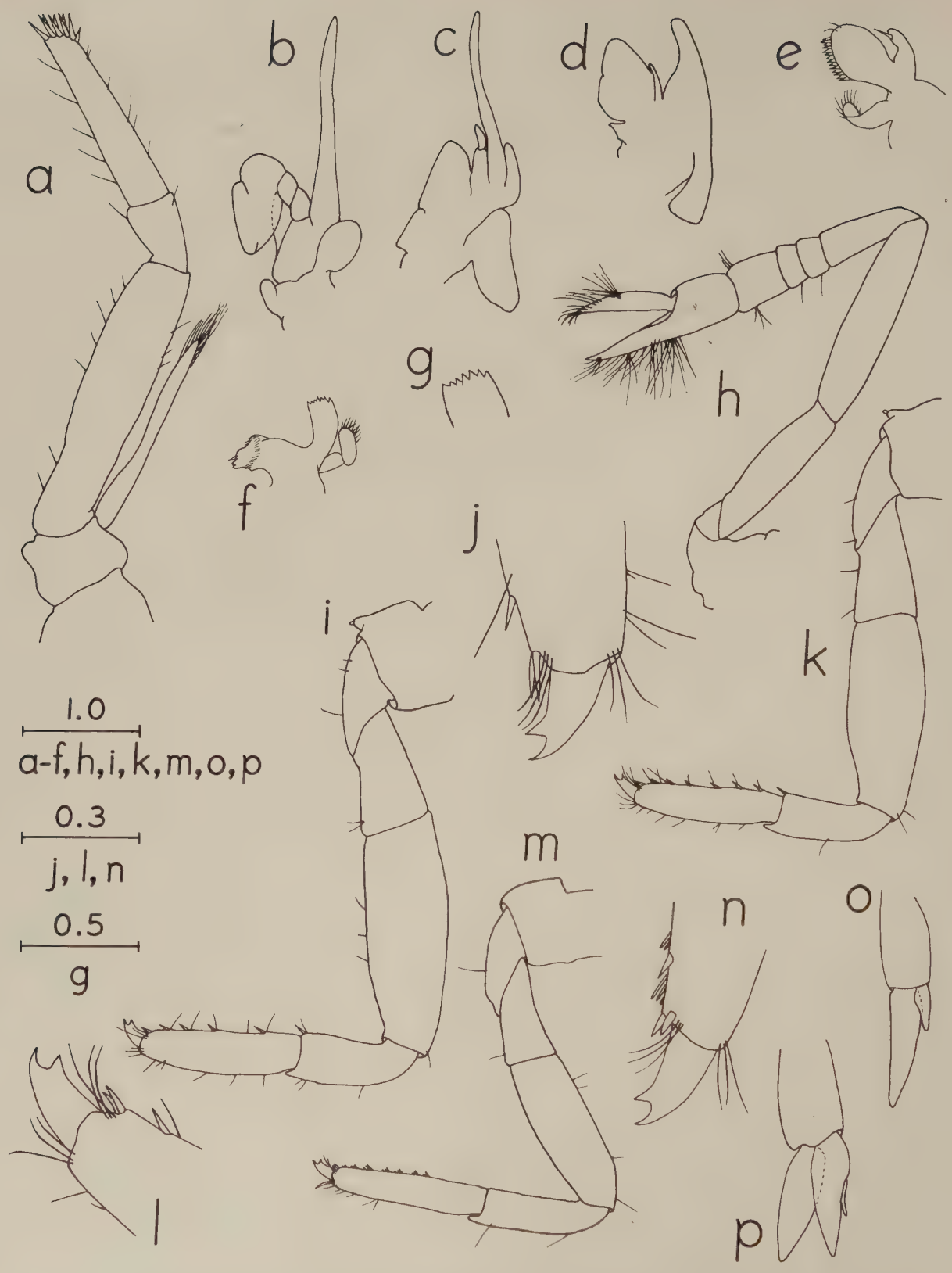

Figure 5. *Synalpheus agelas*, male, CL 5.3, USNM 189147; a. left maxilliped 3; b. left maxilliped 2; c. left maxilliped 1; d. left maxilla 2; e. left maxilla 1; f. left mandible; g. same, incisor process; h. left pereopod 2; i. left pereopod 3; j. same, dactyl; k. left pereopod 4; l. same, dactyl; m. left pereopod 5; n. same, dactyl; o. left pleopod 1; p. left pleopod 2.

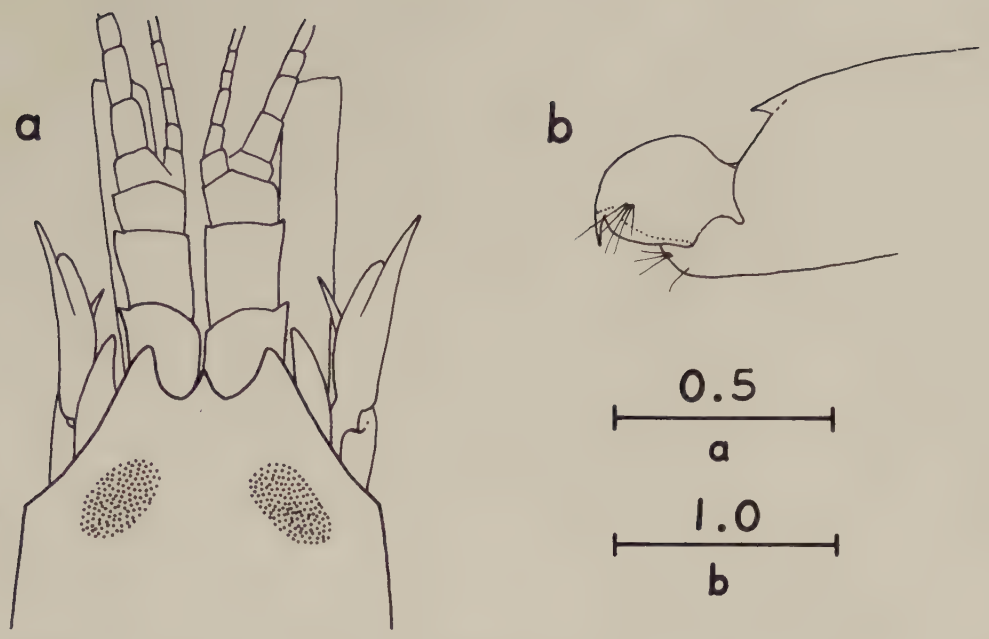

Figure 6. *Synalpheus agelas*, juvenile, CL 2.3, USNM 189145; a. anterior region, dorsal view; b. left major chela, lateral view of distal portion.

Habitat: Known only from the spongocoel of *Agelas dispar* Duchassaing and Michelotti, 1864. Florida Middle Ground specimens were collected from bottom temperatures ranging from 17.1 to 26.0°C and from bottom salinities ranging from 34.6 to 36.2°/∞.

Distribution: Atlantic: Grand Bahama Island; Gulf of Mexico: Florida Middle Ground, Sonnier Bank, 28-Fathom Bank, West Flower Garden Bank, North Hospital Bank, and Hospital Rock (Pequegnat and Heard, 1979); Caribbean: off Puerto Rico (present study). Distributed bathymetrically from 20 to 69 m and perhaps as deep as 91 m (Pequegnat and Heard, 1979).

Remarks: Although both Gulf and Atlantic specimens were collected from sponges of similar size, the Bahamian specimens of *S. agelas* are conspicuously smaller than those from the Gulf of Mexico. The reduced size of Bahamian specimens is not restricted to *S. agelas*. It is evident in all *Synalpheus* species from Bahamian *Agelas*, despite comparable population densities within sponges from both localities.

Synalpheus agelas seems to be distributed throughout the Gulf of Mexico wherever suitable habitat for its host sponge occurs. It is not present in the Hourglass collections, however, probably because *Agelas* encrusts on the underside of coral outcroppings, precluding sampling by dredge or trawl.

Synalpheus agelas is one of eight Western Atlantic *Synalpheus* in which smaller females may carry infertile eggs (see general discussion of reproduction below).

Synalpheus anasimus Chace, 1972

Synalpheus anasimus Chace, 1972, pp. 82-86, figs. 25-28.

Synalpheus anisimanus: Banner and Banner, 1975, p. 274 [erroneous spelling of *anasimus*].

Material examined: 1 ♂, 2.2; Bahía de la Ascensión, Yucatan; 1.5 m; 19 April 1960; Smithsonian-Bredin Station 95-60; HOLOTYPE; USNM 135367.

Diagnosis: Rostrum narrowly triangular, extending beyond bluntly acute ocular hoods, strongly convex ventrally. Carapace carinate in dorsal midline on anterior 1/4 to 1/2. Pleuron of first abdominal somite of male with hook-like tooth posteriorly, that of second broadly rounded, those of remainder progressively more angulate. Telson subtriangular, lateral margins nearly straight; dorsal surface with 2 pairs of spines, both arising in anterior 1/2 of telson. Stylocerite acute, extending to distal 1/4 of first segment of antennular peduncle. Scaphocerite considerably overreaching lateral spine of basicerite, reduced blade present; basicerite not armed dorsally. Palm of major chela terminating dorsodistally in sharp horizontal tooth. Fingers of minor chela subequally bidentate, tips arranged in plane of chela, dactyl with dense fringe of curved hairs on extensor surface; length of carpus about 1/2 that of chela. Carpus of pereopod 2 composed of 4 or 5 articles. Dactyls of posterior 3 pereopods variable, proximal tooth shorter, stouter, and more divergent from distal tooth in females than in males. Lateral branch of uropod with 1 or 2 teeth proximal to movable spine.

Variation: Chace (1972) tentatively attributed the more anterior placement of the dorsal telson spines, the greater number of carpal articles, and the different proportions of the dactylar teeth of the females from Bahía del Espíritu Santo to sexual dimorphism.

Habitat: Upper portions of much eroded coral (Chace, 1972).

Distribution: Caribbean: Known only from the east coast of the Yucatan Peninsula, from depths of 1.5 to 3 m (Chace, 1972).

Remarks: The acceptance of a wide range of variability in this species by Chace (1972) marked a significant departure from the tendency of previous workers to create new taxa to accommodate variant specimens.

Synalpheus androsi Coutière, 1909

Synalpheus androsi Coutière, 1909, pp. 82, 83, fig. 50; Chace, 1972, p. 86.

Material examined: 1 ♀, 4.8; Andros Island, Bahama Islands; F. Stearns (coll.); HOLOTYPE; USNM 38409.

Diagnosis: Rostrum of holotype slender, subequal in length to bluntly triangular right ocular hood, extending beyond broadly rounded left ocular hood, very weakly convex ventrally. Pleura of anterior 5 abdominal somites of female broadly rounded, that of sixth angulate; those of male unknown. Telson broadly triangular, lateral margins slightly concave in posterior 1/4; dorsal surface divided into 3 subequal parts by 2 pairs of small but distinct spines. Stylocerite bluntly triangular, extending to distal 1/4 of first antennular segment. Scaphocerite considerably exceeding lateral spine of basicerite, blade completely lacking; basicerite not armed dorsally. Palm of major chela swollen, terminating dorsodistally in stout spine. Fingers of minor chela simple, fringe of curved hairs present on extensor surface of dactyl; length of carpus just less than 1/2 that of chela. Carpus of pereopod 2 composed of 5 articles. Pereopod 3 with abruptly compressed flanges on merus and carpus. Dactyls of posterior 3 pereopods with proximal tooth very slightly stronger than distal tooth. Lateral branch of uropod with single tooth proximal to movable spine.

Distribution: Atlantic: Known only from the unique type-specimen from Andros Island, Bahamas, from an unknown depth (Coutière, 1909).

Remarks: In the collections of the U.S. National Museum of Natural History, there is a specimen (USNM 110204) from off Barbados which has the compressed flanges on the third pereopod unique to *S. androsi*. The frontal region of this specimen is so aberrant, however, that even the generic determination is uncertain. Coincidentally, the ocular hoods of the holotype are also aberrant.

Synalpheus barahonensis Armstrong, 1949

Synalpheus barahonensis Armstrong, 1949, pp. 20-23, fig. 7; Chace, 1972, p. 86.

Material examined: 1 ♂, damaged; Barahona Harbor, Dominican Republic; J. C. Armstrong (coll.); HOLOTYPE; AMNH 9578. — 1 ♀, 3.6; Barahona Harbor, Dominican Republic; J. C. Armstrong (coll.); PARATYPE; AMNH 9579.

Diagnosis: Rostrum minutely triangular, subequal in length to broadly triangular ocular hoods, very weakly convex ventrally. Pleuron of first abdominal somite of male bearing strongly produced, blunt, curved tooth posteriorly, ventral margins of remaining 5 pleura acute. Telson elongate, narrow posteriorly, lateral margins slightly concave in posterior 1/4; anterior pair of dorsal spines situated at about 1/3 length of segment, posterior pair arising just posterior to mid-length. Stylocerite reaching to distal 1/4 of first segment of antennular peduncle. Scaphocerite subequal in length to lateral spine of basicerite, blade absent; basicerite not armed dorsally. Distal tip of maxilliped 3 provided with setae only, lacking spines. Palm of major chela swollen, terminating dorsodistally in stout spine. Dactyl of minor chela subequally bidentate distally, dense fringe of curved hairs present on extensor surface; fixed finger unknown (neither of the types examined now have minor chelae); length of carpus less than 1/2 that of chela. Carpus of pereopod 2 composed of 4 articles. Dactyls of posterior 3 pereopods with terminal teeth equal and subparallel. Lateral branch of uropod with single tooth proximal to movable spine.

Habitat: From living *Agaricia agaricites* (Linnaeus, 1758) (Armstrong, 1949).

Distribution: Caribbean: Known only from the type-locality in Barahona Harbor, Dominican Republic, from an unknown depth (Armstrong, 1949).

Synalpheus bousfieldi Chace, 1972

Figures 7-10

Synalpheus bousfieldi Chace, 1972, pp. 87-89, figs. 29, 30.

Synalpheus tanneri: Pequegnat and Ray, 1974, pp. 248, 249 [fig. 53c after Coutière's (1909: 77, fig. 47a) illustration of holotype]; Ray, 1974, pp. 170-175, figs. 162-168. [Not *Synalpheus tanneri* Coutière, 1909 (=*S. herricki* Coutière, 1909)].

Synalpheus sp. (near *S. brooksi* Coutière, 1909): Pequegnat and Ray, 1974, pp. 249, 250, fig. 56.

Synalpheus brooksi: Christoffersen, 1979, pp. 335-341, [?] figs. 20-22 [in part]. [Not *Synalpheus brooksi* Coutière, 1909].

Material examined: HOURGLASS STATION C: 1 ♂, 4.1; 31 August 1967; trawl; FSBC I 28310. — HOURGLASS STATION L: 2 ♂, 3.0, 3.2; 6 July 1966; dredge; FSBC I 28311. — FMG STATION 151: 2 ♂, 3.1, 3.4; 1 ♀, 3.5; 26-27 m; 5 October 1978; *Agelas dispar*; MESC 6179-2121. — 1 ♂, 3.8; 1 ovig. ♀, 4.3; 26-27 m; 5 October 1978; *Agelas dispar*; MESC 6179-2122. — 1 ♂, 3.4; 1 ovig. ♀, 4.4; 26-27 m; 5 October 1978; *Agelas dispar*; MESC 6179-2123. — 1 ♂, 2.9; 26 m; 17 January 1979; *Agelas dispar*; MESC 6179-2124. — FMG STATION 247: 2 ♂, 3.4, damaged; 2 ovig. ♀, 3.4, 3.7; 30 m; 13 October 1978; *Madracis decactis*; MESC 6179-2126. — 2 ♂, 2.9, 3.8; 1 ovig. ♀, 4.2; 2 ♀, 3.7, 4.0; 1 juv., 2.3; 30 m; 13 October 1978; *Madracis decactis*; MESC 6179-2127. — FMG STATION 481: 1 juv., 2.2; 27-30 m; 7 October 1978; *Agelas dispar*; MESC 6179-2128. — 2 ♂, 3.5, 3.5; 1 ♀, 3.2; 29 m; 8 October 1978; *Agelas dispar*; MESC 6179-2129. — 1 ♂, 3.7; 1 ♀, 3.5; 29 m; 8 October 1978; *Agelas dispar*; MESC 6179-2130. — 1 ♂, 3.5; 1 ovig. ♀, 4.0; 30-34 m; 8 July 1979; *Agelas dispar*; USNM 189149. — 1 ♂, 2.9; 1 ovig. ♀, 4.2; 30-34 m; 8 July 1979; *Agelas dispar*; MESC 6179-2131. — 1 ♂, damaged; 1 ovig. ♀, 4.2; 30-34 m; 8 July 1979; *Agelas dispar*; MESC 6179-2132. — 1 ♂, 3.6; 1 ovig. ♀, 4.2; 30-34 m; 8 July 1979; *Agelas dispar*; MESC 6179-2133. — 2 ♂, 2.7, 3.3; 1 ovig. ♀, 4.0; 30-34 m; 8 July 1979; *Agelas dispar*; MESC 6179-2134. — FMG STATION 491: 1 ♂, 3.1; 30 m; 14 October 1978; *Madracis decactis*; MESC 6179-2135. — 1 ovig. ♀, 3.3; 29 m; 16 October 1978; *Madracis decactis*; MESC 6179-2136. — 1 ♂, 2.7; 1 ♀, 3.8; 29 m; 26 October 1978; *Agelas dispar*; MESC 6179-2137. — 1 ♂, 2.7; 1 ♀ molt, 3.8; 2 juv., 1.8, 2.3; 29 m; 16 October 1978; *Madracis decactis*; MESC 6179-2138. — 1 ♂, 3.2; 29 m; 17 October 1978; *Agelas dispar*; MESC 6179-2139. — 1 ♂, 3.7; 1 ovig. ♀, 4.4; 30 m; 4 July 1979; *Agelas dispar*; MESC 6179-2140. — 1 ♀ (with infertile eggs), 2.2; 30 m; 4 July 1979; *Agelas dispar*; MESC 6179-2141. — 1 ♂, 3.6; 1 ovig. ♀, 4.1; 30 m; 4 July 1979; *Agelas dispar*; USNM 189148. — OTHER MATERIAL: 1 ovig. ♀, 4.2; 1 ♀, 3.8; Sonnier Bank; 28°20'N, 92°27'W; 25-60 m; 27 September 1977; submersible; TAMU 2-6244. — 12 ♂, 3.0-4.0; 4 ovig. ♀, 3.6-4.4; 4 juv., 1.6-2.0; Bright Bank; 27°53'N, 93°18'W; 55-94 m; 24 September 1977; submersible; TAMU 2-6245. — 1 ♂, 2.8; West Flower Garden Bank; 27°52'N, 93°48'W; 25 m; 3 September 1970; rotenone station; TAMU 2-6251. — 1 juv., 2.1; West Flower Garden Bank; 27°52'N, 93°48'W; 25 m; 9 October 1971; *Agelas dispar*; TAMU 2-6254. — 1 ovig. ♀, 4.0; Sponge Station No. 1; West Flower Garden Bank; 27°52'N, 93°49'W; 25 m; 25 June 1971; TAMU 2-6252. — 4 ♂, 3.2-4.6; 1 ovig. ♀, 4.7; West Flower Garden Bank; 27°52'N, 93°48'W; 25 m; 12 January 1972; dead coral head; TAMU 2-6255. — 1 ♂, 4.0; 1 juv., 2.6; West Flower Garden Bank; 27°52'N, 93°49'W; 48 m; 6 May 1972; diver-collected; TAMU 2-6256. — 9 ♂, 2.0-2.7; 6 ovig. ♀, 2.6-2.8; 4 ♀ (3 with infertile eggs), 1.9-2.1; 2 juv., 1.5, 1.7; Freeport, Grand Bahama Island; 21-23 m; November 1975; diver-collected; *Agelas dispar*; MESC 6179-2142. — 5 ♂ (1 with bopyrid), 1.9-2.4; 4 ovig. ♀, 2.0-2.9; Freeport, Grand Bahama Island; 21-23 m; November 1975; diver-collected; *Agelas dispar*; MESC 6179-2143. — 8 ♂, 1.9-2.7; 9 ovig. ♀, 2.8-3.1; Freeport, Grand Bahama Island; 21-23 m; November 1975; diver-collected; *Agelas dispar*; MESC 6179-2144. — 11 ♂ (1 with bopyrid), 1.8-2.9; 7 ovig. ♀, 2.5-3.3; 4 juv., 1.1-1.6; Freeport, Grand Bahama Island; 21-23 m; November 1975; diver-collected; *Agelas dispar*; USNM 189150. — 2 juv., 1.7, 2.3; Virgin Gorda; 7 April 1958; Smithsonian-Bredin Station 37-58; USNM 136108. — 1 ♀, damaged; 14 juv., 1.8-2.2; Virgin Gorda; 7 April 1958; Smithsonian-Bredin Stations 37-58, 38-58, 39-58; USNM 136109. — 1 ♂, 3.2; 1 ovig. ♀, 3.8; Bahía del Espíritu Santo, Yucatan; 3 m; 6 April 1960; Smithsonian-Bredin Station 41-60; PARATYPES; USNM 135370. — 1 ovig. ♀, 3.2; Bahía del Espíritu Santo, Yucatan; 3 m; 6 April 1960; Smithsonian-Bredin Station 41-60; HOLOTYPE; USNM 135369.

Diagnosis: Rostrum (Figures 7b, 9d, 10a) usually triangular, subequal to or falling short of ocular hoods, convex ventrally; ocular hoods usually broadly rounded. Pleuron of first abdominal somite of male (Figure 9a) bearing blunt, hooked tooth posteriorly, that of second broadly rounded anteroventrally, subrectangular posteroventrally, those of third, fourth, and fifth subrectangular

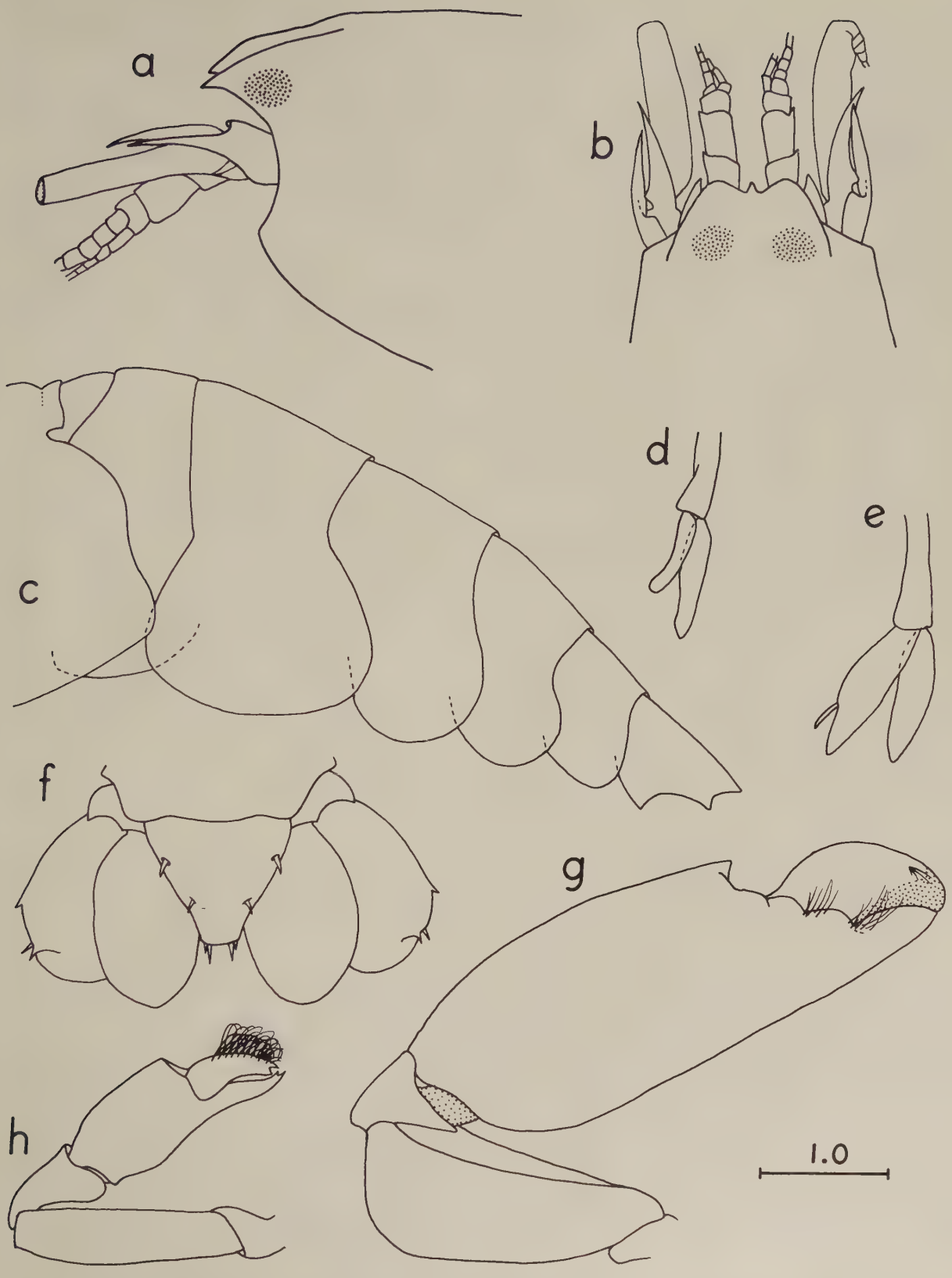

Figure 7. *Synalpheus bousfieldi*, ovigerous female, CL 4.0, USNM 189149; a. anterior region, lateral view; b. same, dorsal view; c. abdomen; d. right pleopod 1; e. right pleopod 2; f. telson and uropods; g. left major chela, mesial view; h. right minor chela.

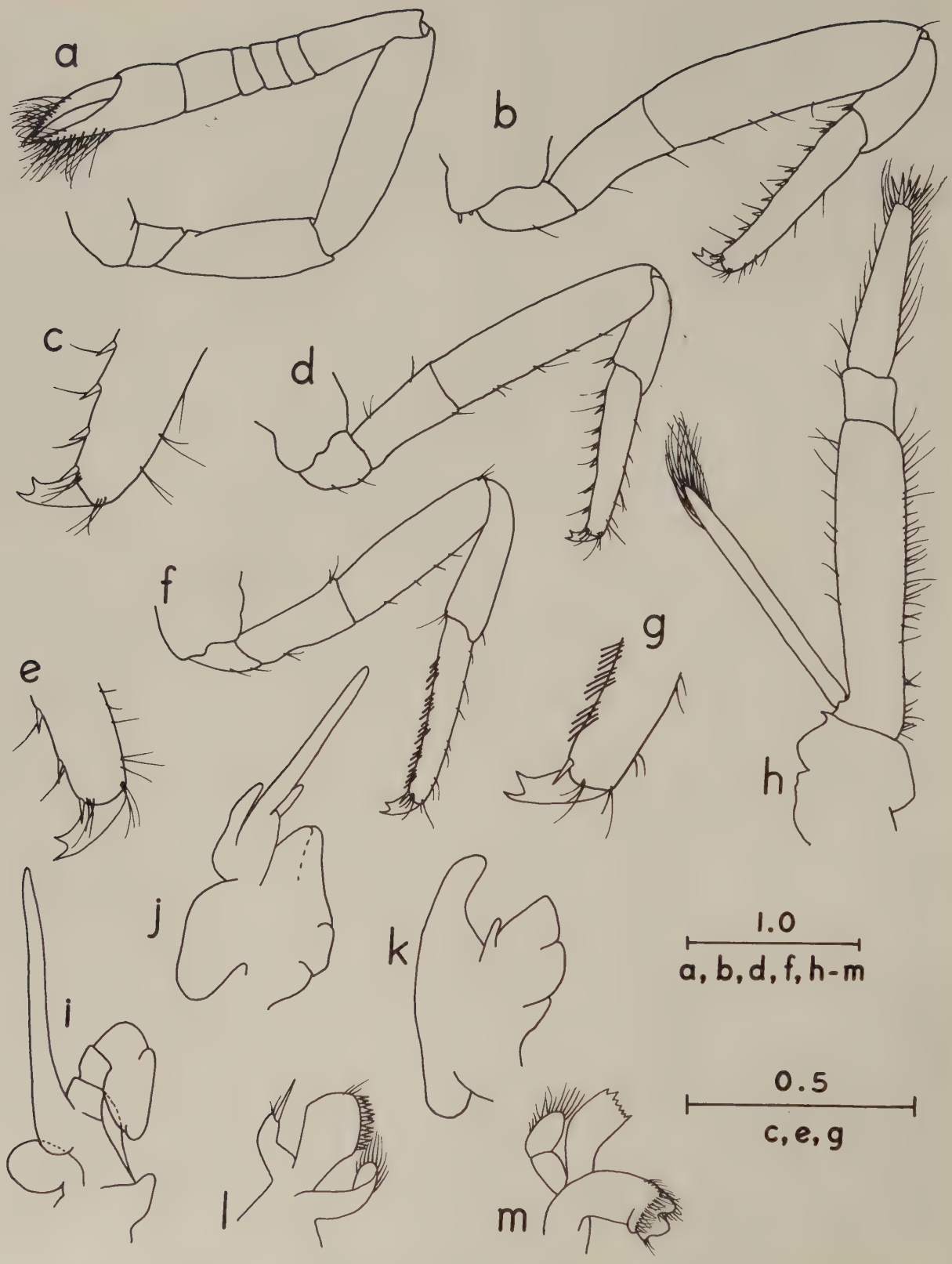

Figure 8. *Synalpheus bousfieldi*, ovigerous female, CL 4.0, USNM 189149; a. right pereopod 2; b. right pereopod 3; c. same, dactyl; d. right pereopod 4; e. same, dactyl; f. right pereopod 5; g. same, dactyl; h. right maxilliped 3; i. right maxilliped 2; j. right maxilliped 1; k. right maxilla 2; l. right maxilla 1; m. right mandible.

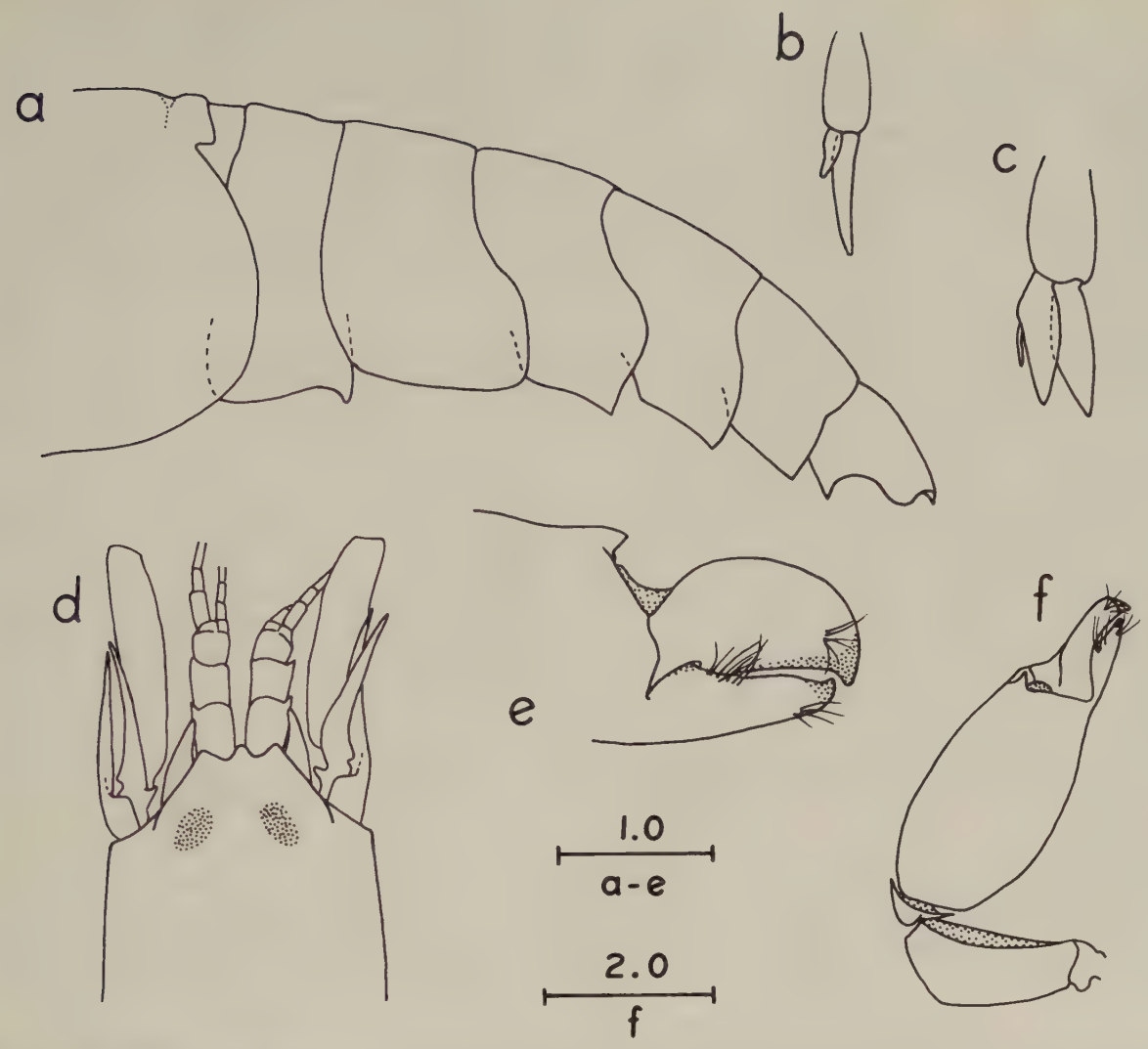

Figure 9. *Synalpheus bousfieldi*, male, CL 3.6, USNM 189148; a. abdomen; b. right pleopod 1; c. right pleopod 2; d. anterior region, dorsal view; e. right major chela, lateral view; f. same, dorsal view.

anteroventrally, acute posteroventrally, that of sixth acuminate. Telson (Figures 7f, 10b) triangular, lateral margins usually concave in posterior 1/4; dorsal surface divided into 3 subequal parts by 2 pairs of small but distinct spines, anterior pair situated very near lateral margins. Stylocerite (Figures 7b, 9d, 10a) usually short and broad, extending just beyond midpoint of first segment of antennular peduncle. Scaphocerite subequal to or slightly exceeding lateral spine of basicerite, blade reduced or absent; basicerite not armed dorsally. Palm of major chela (Figures 7g, 9e) terminating distodorsally in blunt, conical spine. Fingers of minor chela (Figures 7h, 10d) deeply bidentate, tips arranged in plane of fingers, dactyl with dense fringe of curved hairs on extensor surface; length of carpus not quite 1/2 that of chela. Carpus of pereopod 2 (Figure 8a) composed of 4 or 5 articles. Dactyls of posterior 3 pereopods (Figure 8c, e, g) with proximal tooth stronger than and slightly divergent from distal tooth. Lateral branch of uropod (Figures 7f, 10b) usually with single tooth proximal to movable spine.

Variation: The specimens from the Gulf of Mexico (Figures 7, 9) differ from the type-series in the more rounded form of the ocular hoods and in the shape of the distodorsal spine of the major

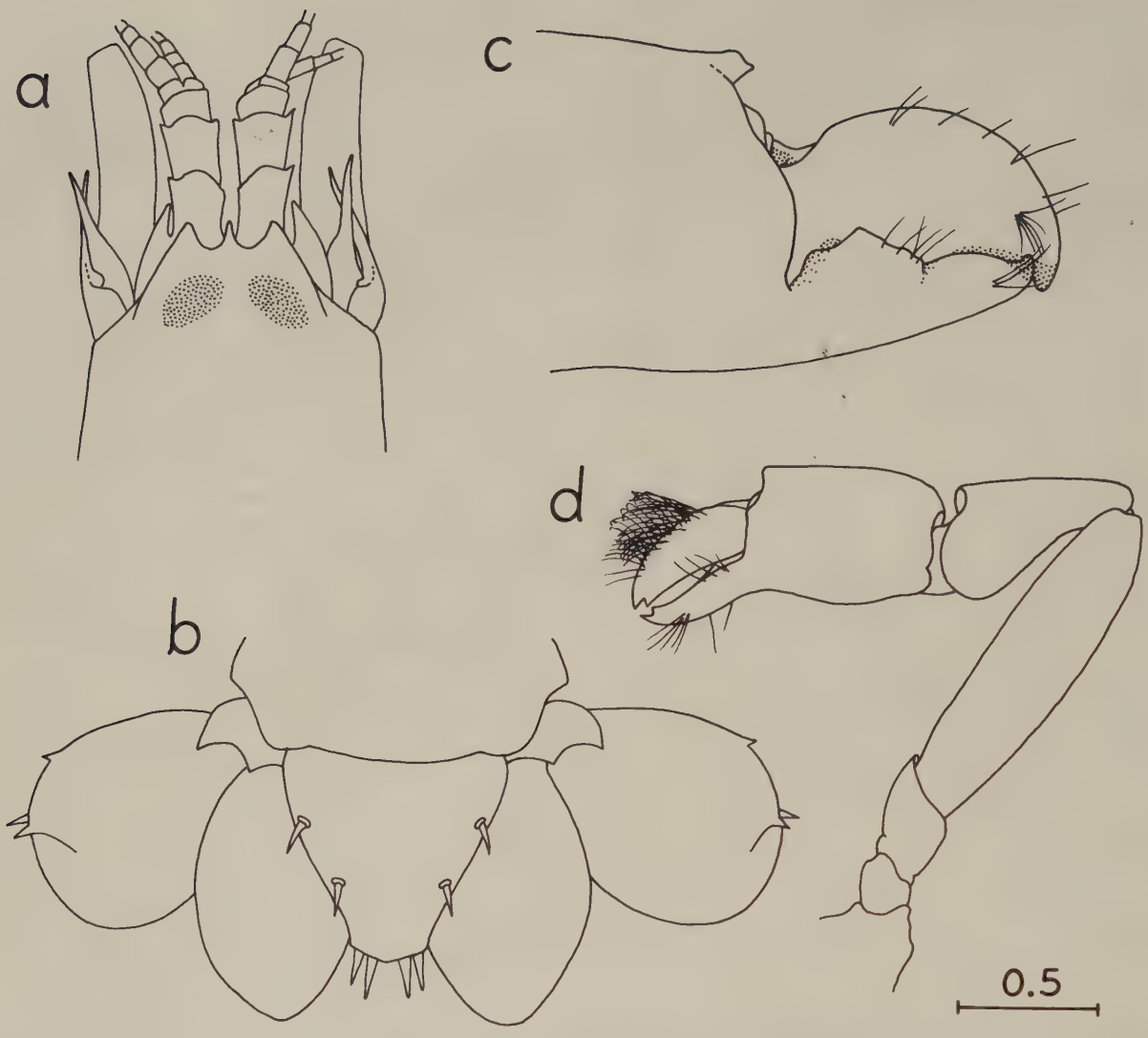

Figure 10. *Synalpheus bousfieldi*, male from Bahama Islands, CL 2.6, USNM 189150; a. anterior region, dorsal view. Ovigerous female from Bahama Islands, CL 2.9, USNM 189150; b. telson and uropods; c. right major chela, lateral view of distal portion; d. left minor chela.

chela. Despite these admittedly marked differences, they are provisionally assigned to *S. bousfieldi* because of their similarity to Chace's (1972) material in most other respects, especially to the Virgin Gorda specimens. Most of the Bahamian specimens (Figure 10) resemble the typical form in the outline of the ocular hoods, but differ from both Gulf and Caribbean material in the shape of the palmar spine of the major chela. The three populations, considered together, exhibit a wide range of variability.

Like all other *Synalpheus* species from the Bahamas examined in this study, these specimens are about half the size of presumed conspecifics from the Gulf of Mexico and the Caribbean. The Bahamian material and the juveniles from Virgin Gorda may possess either four or five articles in the carpus of pereopod 2. All examined specimens from the Gulf of Mexico have five segments.

The degree of angularity of the ocular teeth varies widely in the material examined, ranging from quite broad (Figure 7b) to rather narrow (Figure 10a). The specimens also vary in the lengths of the stylocerites and antennal segments relative to the antennular peduncles. The stylocerite, although usually shorter, may extend as much as 3/4 the length of the first antennular segment. The distal tip of the scaphocerite may reach anywhere from the distal margin of the first segment to beyond the proximal margin of the third segment of the antennular peduncle. The basicerite, typically subequal to the scaphocerite, is occasionally shorter.

Size (CL in mm): Gulf of Mexico and Caribbean specimens: males, 2.7-4.6; ovigerous females, 3.3-4.7; females, 3.2-4.1; female with infertile eggs, 2.2; juveniles, 1.6-2.6. Bahamian specimens: males, 1.8-2.9; ovigerous females, 2.0-3.3; females with infertile eggs, 1.9-2.1; juveniles, 1.1-1.7.

Habitat: From dead and eroded coral (Chace, 1972; Pequegnat and Ray, 1974). The Florida Middle Ground material was taken from a living coral, *Madracis decactis* (Lyman, 1857) and from a sponge, *Agelas dispar*. Each sponge usually contained a single male-female pair of *S. bousfieldi*, as well as much larger populations of *S. agelas* and *S. townsendi*. Specimens from the Bahama Islands, although likewise collected from *A. dispar*, did not necessarily occur in pairs. Although specific habitat for many of the western Gulf specimens was not noted, all were associated with a reef biotope. Hourglass specimens were collected from bottom temperatures of 21.0 and 22.0°C and from bottom salinities of 36.3 and 36.5°/oo. Bottom water temperatures from which Florida Middle Ground specimens were collected ranged from 17.1 to 26.0°C, while bottom salinities ranged from 34.6 to 36.2°/oo.

Distribution: Atlantic: Grand Bahama Island (present study) and possibly south to Brazil (Christoffersen, 1979); Gulf of Mexico: Florida Middle Ground, Sonnier Bank, Bright Bank, and West Flower Garden Bank (present study); Caribbean: Yucatan Peninsula and the Virgin Islands (Chace, 1972). Distributed bathymetrically from 3 m (Chace, 1972) to 55 m, and perhaps as deep as 94 m (present study).

Remarks: Highly variable characters were utilized by Chace (1972) to separate *S. bousfieldi* from the closely related *S. brooksi*. Lacking sufficient material to recognize specific differences, Christoffersen (1979) considered *S. bousfieldi* to be a junior synonym of *S. brooksi*. Although these two species are difficult to separate, use of the characters in Table 5 (p. 54) will permit identification of all but the most aberrant adults. The proximity of the anterior pair of telson spines to the lateral margins seems to be the most stable character which distinguishes *S. bousfieldi* from *S. brooksi*. Unfortunately, Christoffersen's figures are not sufficiently detailed to determine whether any of his material was actually *S. bousfieldi*.

Pequegnat and Ray (1974) and Ray (1974) recognized the similarity of their specimens to *S. bousfieldi* but chose to treat them as probable synonyms of *S. tanneri*. Pequegnat and Ray (1974) also reported several specimens having the basicerite shorter than the scaphocerite as *Synalpheus* sp. (near *S. brooksi* Coutière, 1909). Examination of their material revealed that it all belonged to a single species identical to the eastern Gulf specimens I have assigned to *S. bousfieldi*.

Each of the non-ovigerous Middle Ground females had swollen ovaries, preparatory to laying eggs, or had recently carried egg masses. The incidence of infertile eggs was higher among female *S. bousfieldi* from the Bahamas than among those from the Gulf of Mexico.

Synalpheus brevifrons Chace, 1972

Synalpheus brevifrons Chace, 1972, pp. 89-92, figs. 31, 32.

Material examined: 1 ♀, 2.8; Woodbridge Bay, Dominica; 26 March 1956; Smithsonian-Bredin Station 55-56; HOLOTYPE; USNM 135371.

Diagnosis: Rostrum small, broadly acute, falling slightly short of broadly and obscurely obtuse ocular hoods, convex ventrally. Pleura of anterior 3 abdominal somites of female broadly rounded, those of fourth and fifth with acute tooth anteroventrally, broadly rounded posteroventrally, that of sixth acuminate; those of male unknown. Telson triangular, lateral margins nearly straight, armed with 2 pairs of stout spines arising from lateral margins, anterior pair situated slightly anterior to midlength of telson, posterior pair midway between anterior pair and posterior margin. Stylocerite long, broad, extending to distal 1/4 of first segment of antennular peduncle. Scaphocerite considerably overreaching lateral spine of basicerite, blade completely lacking; basicerite not armed dorsally. Palm of major chela terminating dorsodistally in rounded tubercle. Fingers of minor chela subequally bidentate, tips arranged in plane of chela, dactyl with fringe of curved hairs on extensor surface; length of carpus slightly more than 1/2 that of chela. Carpus of pereopod 2 composed of 5 articles. Dactyls of posterior 3 pereopods with proximal tooth stronger than and slightly divergent from distal tooth. Lateral branch of uropod with single tooth proximal to movable spine.

Habitat: On coral encrusted boulders (Chace, 1972).

Distribution: Caribbean: Known only from the unique type-specimen from Woodbridge Bay, Dominica, from a depth of less than 1 m (Chace, 1972).

Remarks: Although the left maxilliped 3 figured by Chace (1972) is devoid of terminal spines, and the distal tip of the right one is damaged, it appears that the spines were present at one time.

Synalpheus brooksi Coutière, 1909

Figures 11-14

Synalpheus laevimanus var. *longicarpus*: Coutière, 1898, pp. 188-191, [?] figs. 2, 2b [in part]; 1899, pp. 314, 436, 464, 466, figs. 394, 407 [? in part]; 1900, p. 357 [? in part]. [Not *Alpheus laevimanus* Heller, 1862, =*Synalpheus gambarelloides* (Nardo, 1847); not *Alpheus saulcyi* var. *longicarpus* Herrick, 1891].

Synalpheus laevimanus var. *longicarpus* β: Coutière, 1899, pp. 315, 420, 446-449, 466 [? in part]. [Not *Alpheus laevimanus* Heller, 1862, =*Synalpheus gambarelloides* (Nardo, 1847); not *Alpheus saulcyi* var. *longicarpus* Herrick, 1891].

Synalpheus longicarpus β: Coutière, 1899, pp. 454, 468 [? in part]; 1909, p. 3 [in part]. [Not *Alpheus saulcyi* var. *longicarpus* Herrick, 1891].

Synalpheus laevimanus longicarpus: Rathbun, 1901, p. 110 [in part]. [Not *Alpheus laevimanus* Heller, 1862, =*Synalpheus gambarelloides* (Nardo, 1847); not *Alpheus saulcyi* var. *longicarpus* Herrick, 1891].

Synalpheus laevimanus parfaiti: Rathbun, 1901, p. 110 [in part]. [Not *Alpheus laevimanus* Heller, 1862, =*Synalpheus gambarelloides* (Nardo, 1847); not *Synalpheus laevimanus parfaiti* Coutière, 1898].

Synalpheus brooksi Coutière, 1909, pp. 69-72, fig. 41; 1910, p. 487; McClendon, 1911, pp. 57-60, pl. 1, figs. 1, 3; Pearse, 1932a, p. 107; 1932b, pp. 119-122; Arndt, 1933, pp. 248-250; Schmitt, 1935, p. 148; DeLaubenfels, 1936, p. 141; Pearse, 1950, p. 150; Holthuis, 1959, p. 104; Dobkin, 1965, pp. 450-462, figs. 1-5; 1969, p. 941; Lyons et al., 1971, p. 30; Chace, 1972, p. 92; Coelho and Ramos, 1972, p. 151; Heard and Perlmutter, 1977, p. 40; Christoffersen, 1979, pp. 335-341, [?] figs. 20-22 [in part]; Rodriguez, 1980, pp. 158, 159; Westinga and Hoetjes, 1981, pp. 139-150.

Synalpheus brooksi strepsiceros Coutière, 1909, pp. 72, 73, fig. 42.

Synalpheus brooksi eleutherae Coutière, 1909, pp. 72, 73, fig. 43.

[?]*Synalpheus herricki*: Rouse, 1970, pp. 138, 139. [? Not *Synalpheus herricki* Coutière, 1909].

Synalpheus n. sp.: Lyons et al., 1971, p. 31.

[?]*Synalpheus longicarpus*: Corrêa, 1972, p. 3. [Not *Alpheus saulcyi* var. *longicarpus* Herrick, 1891].

[?]*Synalpheus ?brooksi*: Fausto-Filho and Sampaio Neto, 1976, p. 67.

Material examined: HOURGLASS STATION B: 2 ♂, 4.6, 4.8; 1 subadult, 4.0; 7 February 1966; trawl; FSBC I 28312. — 2 ovig. ♀, 4.8, 4.8; 1 subadult, 3.6; 1 juv., 3.1; 5 October 1967; trawl; FSBC I 28313. — HOURGLASS STATION C: 1 juv., 2.5; 31 August 1965; dredge; FSBC I 28314. — 1 ovig. ♀, 4.8; 1 juv., 3.0; 5 October 1965; dredge; FSBC I 28315. — 1 ♂, 4.3; 1 ovig. ♀, 4.1; 3 January 1966; dredge; FSBC I 28316. — 1 ovig. ♀, 4.7; 1 subadult, 3.6; 2 juv., 2.6, 2.9; 7 February 1966; trawl; FSBC I 28317. — 1 subadult (with infertile eggs), 3.2; 7 February 1966; dredge; FSBC I 28318. — 1 ♂, 4.8; 2 ovig. ♀, 4.2, 5.1; 1 subadult, 3.4; 1 juv., 2.1; 3 March 1966; trawl; FSBC I 28319. — 1 ♂, 4.4; 2 juv., 1.9, 2.7; 6 April 1966; trawl; FSBC I 28320. — 1 ♂, 4.6; 1 ovig. ♀, 5.0; 1 subadult, 3.4; 6 April 1966; dredge; FSBC I 28321. — 1 ♂, 4.5; 2 ovig. ♀, 4.2, 4.6; 2 subadults (1 with bopyrid, 3.8; 1 with infertile eggs, 3.8); 2 juv., 2.8, 3.0; 16 April 1966; dredge; FSBC I 28322. — 2 subadults, 3.2, 3.6; 19 May 1966; trawl; FSBC I 28323. — 1 subadult (with bopyrid), 3.2; 18 June 1966; trawl; FSBC I 23869. — 7 ♂, 3.8-4.9; 11 ovig. ♀, 4.1-5.0; 26 subadults (1 with infertile eggs, 3.6), 3.2-3.6; 21 juv., 2.3-3.1; 18 June 1966; trawl; FSBC I 28324. — 2 ♂, 4.3, 4.7; 1 ovig. ♀, 4.9; 8 subadults (2 with infertile eggs, 3.5, 4.1), 3.1-4.1; 11 July 1966; dredge; FSBC I 28325. — 1 subadult, 3.2; 1 August 1966; dredge; FSBC I 28326. — 1 ♂, 5.0; 4 subadults (2 with infertile eggs, 3.7, 3.9), 3.7-3.9; 11 August 1966; trawl; FSBC I 28327. — 2 ♂, 4.4, 4.7; 31 August 1966; trawl; FSBC I 28328. — 1 subadult (with bopyrid), 3.4; 8 September 1966; trawl; FSBC I 23872. — 1 ♀ (with bopyrid), 4.1; 2 subadults (with bopyrids), 3.2, 3.5; 8 September 1966; trawl; FSBC I 23895. — 26 ♂ (2 with bopyrids), 3.9-5.4; 22 ovig. ♀, 4.0-5.2; 108 subadults (6 with bopyrids; 14 with infertile eggs, 3.4-3.8), 3.2-3.9; 79 juv., 1.4-3.1; 20 damaged; 8 September 1966; trawl; FSBC I 28329. — 1 subadult, 3.6; 8 October 1966; dredge; FSBC I 28330. — 1 subadult, 3.7; 19 November 1966; dredge; FSBC I 28331. — 1 subadult, 3.2; 13 December 1966; trawl; FSBC I 28332. — 1 juv., 2.9; 13 December 1966; dredge; FSBC I 28333. — 3 ♂, 4.1-5.0; 1 ovig. ♀, 5.0; 11 subadults (1 with bopyrid; 1 with infertile eggs, 3.5), 3.2-3.9; 11 juv., 2.2-2.9; 1 damaged; 25 January 1967; trawl; FSBC I 28334. — 1 ovig. ♀, 5.0; 5 February 1967; dredge; FSBC I 28335. — 1 ♂, 4.9; 1 juv., 3.0; 12 April 1967; trawl; FSBC I 28336. — 2 ovig. ♀, 4.8, 4.8; 12 subadults (1 with bopyrid), 3.2-3.5; 2 juv., 2.5, 2.8; 3 damaged; 11 July 1967; trawl; FSBC I 28337. — 1 ♂, 4.5; 2 ovig. ♀, 5.2, 5.4; 5 subadults, 3.1-3.9; 1 August 1967; trawl; FSBC I 28338. — 1 juv., 2.6; 31 August 1967; trawl; FSBC I 28339. — 2 ♂, 4.4, 4.4; 2 ovig. ♀, 5.0, 5.1; 7 subadults (1 with infertile eggs, 3.8), 3.2-3.8; 2 juv., 2.5, 2.6; 5 October 1967; trawl; FSBC I 28340. — 2 ♂, 3.9, 4.1; 1 juv., 2.0; 5 October 1967; dredge; FSBC I 28341. — 1 ♂ (with bopyrid), 5.0; 1 ovig. ♀, 5.0; 2 juv., 2.2, 2.9; 25 October 1967; trawl; FSBC I 28342. — 1 juv., 2.8; 2 November 1967; trawl; FSBC I 28343. — 1 juv., 1.8; 21 November 1967; dredge; FSBC I 28344. — HOURGLASS STATION D: 1 ovig. ♀, 4.9; 16 April 1966; trawl; FSBC I 28345. — 9 ♂, 4.1-5.0; 9 ovig. ♀, 4.6-5.3; 38 subadults (13 with infertile eggs, 3.2-3.9), 3.1-3.9; 37 juv. (1 with bopyrid), 1.4-3.1; 3 damaged; 26 January 1967; trawl; FSBC I 28346. — 1 ovig. ♀, 5.1; 2 subadults, 3.4, 3.4; 6 February 1967; trawl; FSBC I 28347. — HOURGLASS STATION E: 1 juv., 2.6; 26 January 1967; trawl; FSBC I 28348. — 1 juv., 2.6; 2 August 1967; dredge; FSBC I 28349. — HOURGLASS STATION J: 1 ovig. ♀, 4.8; 7 juv., 2.6-3.1; 12 October 1966; trawl; FSBC I 28350. — HOURGLASS STATION K: 2 subadults, 3.4, 4.0; 1 juv., 2.6; 6 August 1965; trawl; FSBC I 28351. — 2 juv., 2.9, 3.0; 13 October 1965; trawl; FSBC I 28352. — 1 ♂, 4.8; 2 ovig. ♀, 4.1, 4.6 (with hemiarthrine); 4 juv., 2.0-3.1; 13 January 1966; trawl;

FSBC I 28353. — 1 subadult, 3.7; 2 juv., 2.6, 3.0; 13 January 1966; dredge; FSBC I 28354. — 1 subadult (with bopyrid), 3.7; 21 March 1966; trawl; FSBC I 23878. — 1 ovig. ♀, 4.5; 3 subadults (1 with bopyrid), 3.3-3.9; 21 March 1966; trawl; FSBC I 28355. — 1 subadult, 3.9; 11 May 1966; trawl; FSBC I 28356. — 1 ♂, 4.2; 1 ovig. ♀, 4.0; 7 subadults (1 with bopyrid; 2 with infertile eggs, 3.9, 3.9), 3.2-3.9; 2 juv. (1 with bopyrid), 3.0, 3.0; 5 July 1966; trawl; FSBC I 28357. — 17 ♂, 3.9-5.2; 19 ovig. ♀, 4.2-5.5; 105 subadults (16 with infertile eggs, 3.5-4.0), 3.2-4.0; 5 juv., 2.9-3.1; 6 damaged; 22 July 1966; trawl; FSBC I 28358. — 1 ovig. ♀, 4.9; 4 subadults, 3.4-3.9; 2 juv., 3.0, 3.0; 5 August 1966; trawl; FSBC I 28359. — 1 subadult, 3.6; 5 August 1966; dredge; FSBC I 28360. — 2 ♂ (each with different bopyrids), 4.1, 4.2; 4 September 1966; trawl; FSBC I 23868, 23870. — 1 ♂, 5.1; 2 ovig. ♀, 4.0 (with hemiarthrine), 4.8; 18 subadults (2 with infertile eggs, 3.6, 3.9), 3.1-3.9; 4 September 1966; trawl; FSBC I 28361. — 1 juv., 2.4; 12 October 1966; dredge; FSBC I 28362. — 1 juv., 2.7; 12 November 1966; trawl; FSBC I 28363. — 6 ♂, 3.9-5.2; 4 ovig. ♀, 4.4-5.2; 28 subadults (1 with infertile eggs, 3.7), 3.1-3.9; 18 juv., 1.8-3.0; 12 January 1967; trawl; FSBC I 28364. — 1 ♂, 4.0; 1 ovig. ♀, 4.8; 10 subadults (3 with infertile eggs, 3.4-3.8), 3.3-3.8; 11 juv., 2.2-3.1; 30 January 1967; trawl; FSBC I 28365. — 2 ♂, 4.0, 4.2; 1 ovig. ♀, 4.3; 6 subadults (2 with infertile eggs, 4.0, 4.0), 3.2-4.0; 9 juv., 2.0-3.1; 15 February 1967; trawl; FSBC I 28366. — 2 subadults, 3.1, 3.8; 8 March 1967; dredge; FSBC I 28367. — 13 ♂, 4.2-5.3; 13 ovig. ♀ (1 with bopyrid), 4.2-5.2; 33 subadults (4 with infertile eggs, 3.4-4.2), 3.1-4.2; 30 juv., 1.5-3.0; 7 April 1967; trawl; USNM 189151. — 1 subadult, 3.5; 1 juv., 2.5; 7 April 1967; dredge; FSBC I 28368. — 2 subadults, 3.4, 3.4; 5 July 1967; dredge; FSBC I 28670. — 3 ♂, 4.4-5.2; 1 ovig. ♀, 4.4; 1 subadult, 3.6; 1 juv. (with bopyrid), 2.9; 4 September 1967; trawl; FSBC I 28369. — 1 ♂, 4.0; 3 ovig. ♀, 5.3-5.6; 9 subadults, 3.4-3.9; 1 juv., 2.2; 2 damaged; 14 November 1967; dredge; FSBC I 28370. — HOURGLASS STATION L: 1 ♂, 4.1; 1 ovig. ♀, 4.0; 1 subadult, 3.7; 22 July 1966; trawl; FSBC I 28371. — 1 ♂, 3.8; 1 ovig. ♀, 4.6; 1 juv., 2.7; 5 September 1966; dredge; FSBC I 28372. — 1 ♂, 4.3; 1 subadult, 3.1; 1 juv., 2.0; 1 damaged; 13 January 1967; trawl; FSBC I 28373. — 1 ovig. ♀, 4.4; 16 May 1967; dredge; FSBC I 28374. — HOURGLASS STATION M: 1 juv., 3.0; 13 January 1967; dredge; FSBC I 28375. — FMG STATION 151: 2 subadults, 3.5, 3.9; 1 juv., 2.8; 26-27 m; 5 October 1978; *Agelas dispar*; MESC 6179-2145. — 1 subadult, 3.0; 26 m; 17 January 1979; *Agelas dispar*; MESC 6179-2146. — 2 subadults, 3.0 (with infertile eggs), 3.1; 26 m; 17 January 1979; *Agelas dispar*; MESC 6179-2147. — FMG STATION 247: 2 subadults, 3.1, 3.7; 27 m; 11 October 1978; *Agelas dispar*; MESC 6179-2148. — 1 ♂, 4.0; 1 ovig. ♀, 4.2; 1 subadult, 3.8; 27-30 m; 12 October 1978; *Agelas dispar*; MESC 6179-2149. — 1 subadult, 3.4; 26-30 m; 30 January 1979; *Agelas dispar*; MESC 6179-2150. — 1 ♂, 4.5; 1 ovig. ♀, 5.1; 29 m; 21 June 1979; *Agelas dispar*; MESC 6179-2151. — 3 juv., 3.0-3.2; 27-29 m; 21 June 1979; *Agelas dispar*; MESC 6179-2152. — 8 ♂, 4.0-4.9; 12 ovig. ♀ (1 with bopyrid), 4.0-5.3; 22 subadults (2 with infertile eggs, 3.4, 3.9), 3.1-3.9; 44 juv., 2.3-3.0; 26 m; 23 June 1979; *Spheciospongia vesparium*; USNM 189152. — FMG STATION 481: 1 subadult, 3.4; 1 juv., 2.6; 27-29 m; 6 October 1978; *Agelas dispar*; MESC 6179-2153. — FMG STATION 491: 3 ovig. ♀, 3.8-4.8; 1 ♂ (with hemiarthrine), 4.6; 3 subadults, 3.4-3.8; 29 m; 16 October 1978; *Agelas dispar*; MESC 6179-2154. — 3 ♂, 4.1-4.7; 1 ovig. ♀, 4.9; 14 subadults (7 with infertile eggs, 3.4-4.1), 3.1-4.1; 29 m; 16 October 1978; *Agelas dispar*; MESC 6179-2155. — 1 ovig. ♀, 4.3; 29 m; 16 October 1978; *Agelas dispar*; MESC 6179-2156. — 3 subadults, 3.0-3.8; 33 m; 17 October 1978; *Agelas dispar*; MESC 6179-2157. — 3 subadults (1 with hemiarthrine; 1 with infertile eggs, 3.7), 3.6-3.8; 29 m; 17 October 1978; *Agelas dispar*; MESC 6179-2158. — 1 ♂, 4.1; 1 ovig. ♀, 4.4; 1 subadult, 3.5; 2 juv., 2.9, 3.0; 30 m; 4 July 1979; *Agelas dispar*; MESC 6179-2159. — 1 subadult, 3.5; 30 m; 4 July 1979; *Agelas dispar*; MESC 6179-2160. — 1 juv., 2.3; 30 m; 4 July 1979; *Agelas dispar*; MESC 6179-2161. — OTHER MATERIAL: 6 ovig. ♀, 3.4-4.6; 5 subadults (all with infertile eggs), 3.4-4.0; 1 juv., 2.2; 1 damaged, 3.8; Sugar Loaf Key, Florida; SYNTYPES; USNM 38402. — 1 subadult, 3.8; St. Thomas, Virgin Islands; HOLOTYPE of *S. brooksi strepsiceros*; USNM 8936. — 6 ♂, 3.8-4.6; 2 ovig. ♀, 4.7, 4.8; Eleuthera, Bahama Islands; SYNTYPES of *S. brooksi eleutherae*; USNM 38403.

— 1 ♂, 4.9; off Crystal River, Florida; 28°55'N, 82°51'W; 5 m; 8 October 1969; Crystal River Station VI-2; FSBC I 7665.

Diagnosis: Rostrum (Figures 11a, 12a) narrower and usually longer than triangular ocular hoods, very weakly convex ventrally. Pleuron of first abdominal somite of male (Figure 11b) bearing hooked tooth posteriorly, that of second rounded, those of third and fourth subrectangular, those of fifth and sixth acuminate. Telson (Figure 11h) elongate, considerably narrower posteriorly than anteriorly, lateral margins nearly straight; dorsal surface divided into 3 subequal parts by 2 pairs of spines. Stylocerite (Figures 11a, 12a) usually short and broad, extending just beyond midpoint of first segment of antennular peduncle. Scaphocerite subequal to or slightly exceeding lateral spine of basicerite, blade absent; basicerite not armed dorsally. Palm of major chela (Figures 11f, 12g) terminating distodorsally in slender, sharp spine. Fingers of minor chela (Figures 11g, 13a) deeply bidentate, tips arranged in plane of fingers, dactyl with fringe of curved hairs on extensor surface; length of carpus about 1/2 that of chela. Carpus of pereopod 2 (Figure 13b) usually with 5 articles. Dactyls of posterior 3 pereopods (Figure 13d, f, h) with terminal teeth subparallel, proximal tooth slightly stronger than distal tooth. Lateral branch of uropod (Figures 11h, 12f) usually with single tooth proximal to movable spine.

Variation (also see *Remarks*): The ocular hoods are usually elongate, with the axes divergent and the tips pointed; an occasional specimen may have them more rounded but never to the degree found in *S. bousfieldi*. The lateral spine of the basicerite may vary from half the length of the scaphocerite to nearly subequal in length and occasionally extends beyond.

Coutière (1909) discussed and figured the variation in the proportions of the palm of the major chela. The angle of the distodorsal spine relative to the palm also varies. Usually directed obliquely upward at a 45° angle (Figure 11f), its position may range throughout an arc to an almost parallel attitude.

The spination of the telson and uropods varies widely; spines may be missing or additional spines may be present. Figure 11e shows a specimen with the movable spines absent from the uropods; the specimen shown in Figure 11i lacks sutural spines, and the left side of the telson of the specimen in Figure 12f has extra spines, both posteriorly and dorsally. Holthuis (1959) and Christoffersen (1979) noted specimens with two teeth proximal to the movable spine of the uropods rather than the usual one. The undifferentiated, lobate telson with a single posterior spine shown in Figure 11i may have been regenerated; I have seen specimens of *S. longicarpus* with a similar telson. Specimens rarely have the anterior pair of dorsal spines originating in the posterior 1/2 of the telson (Figure 11e). They are typically situated as in Figure 11h.

Coutière (1909) pointed out that juveniles of *S. brooksi* may have only four articles in the carpus of pereopod 2. Postlarvae may have as few as three articles (Dobkin, 1965).

Color: Based on notes taken from live material from the Florida Middle Ground: Carapace and dorsal surface of abdomen transparent orange yellow, abdominal pleura clear ventrally; light scattering of contracted dark chromatophores in rostral region; ovaries light greenish brown; eggs translucent white; telson and uropods clear. Antennae and antennules clear, with scattered dark chromatophores on antennae. Pereopods and maxilliped 3 clear; major and minor pereopods 1 with golden red highlights on margins of fingers. McClendon (1911) gave superficial color notes and a color plate of a whole specimen and of a major chela.

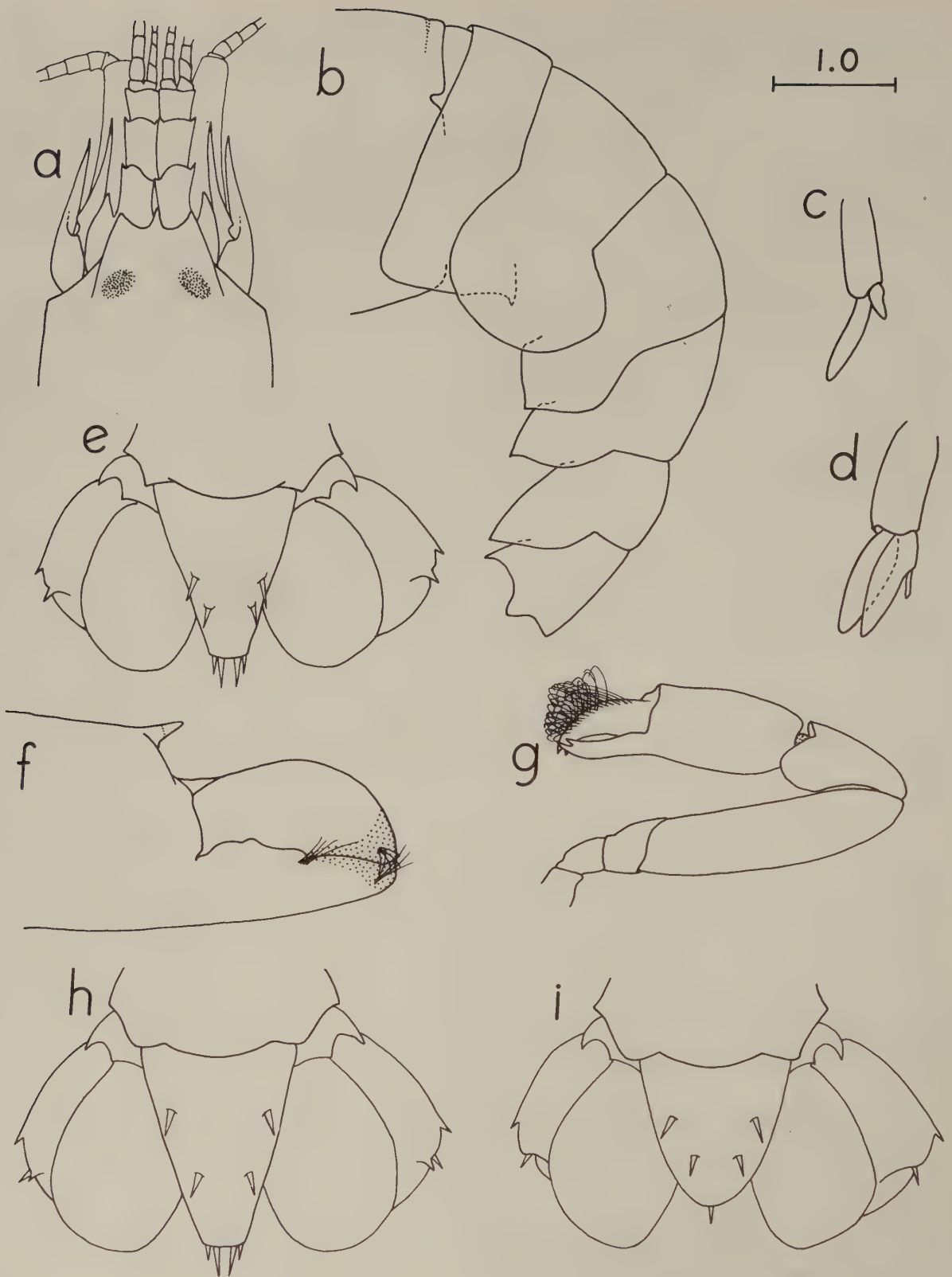

Figure 11. *Synalpheus brooksi*, male, CL 4.8, USNM 189152; a. anterior region, dorsal view; b. abdomen; c. left pleopod 1; d. left pleopod 2; e. telson and uropods; f. right major chela, lateral view of distal portion; g. left minor chela. Male, CL 5.0, USNM 189151; h. telson and uropods. Ovigerous female, CL 5.7, FSBC I 28346; i. telson and uropods.

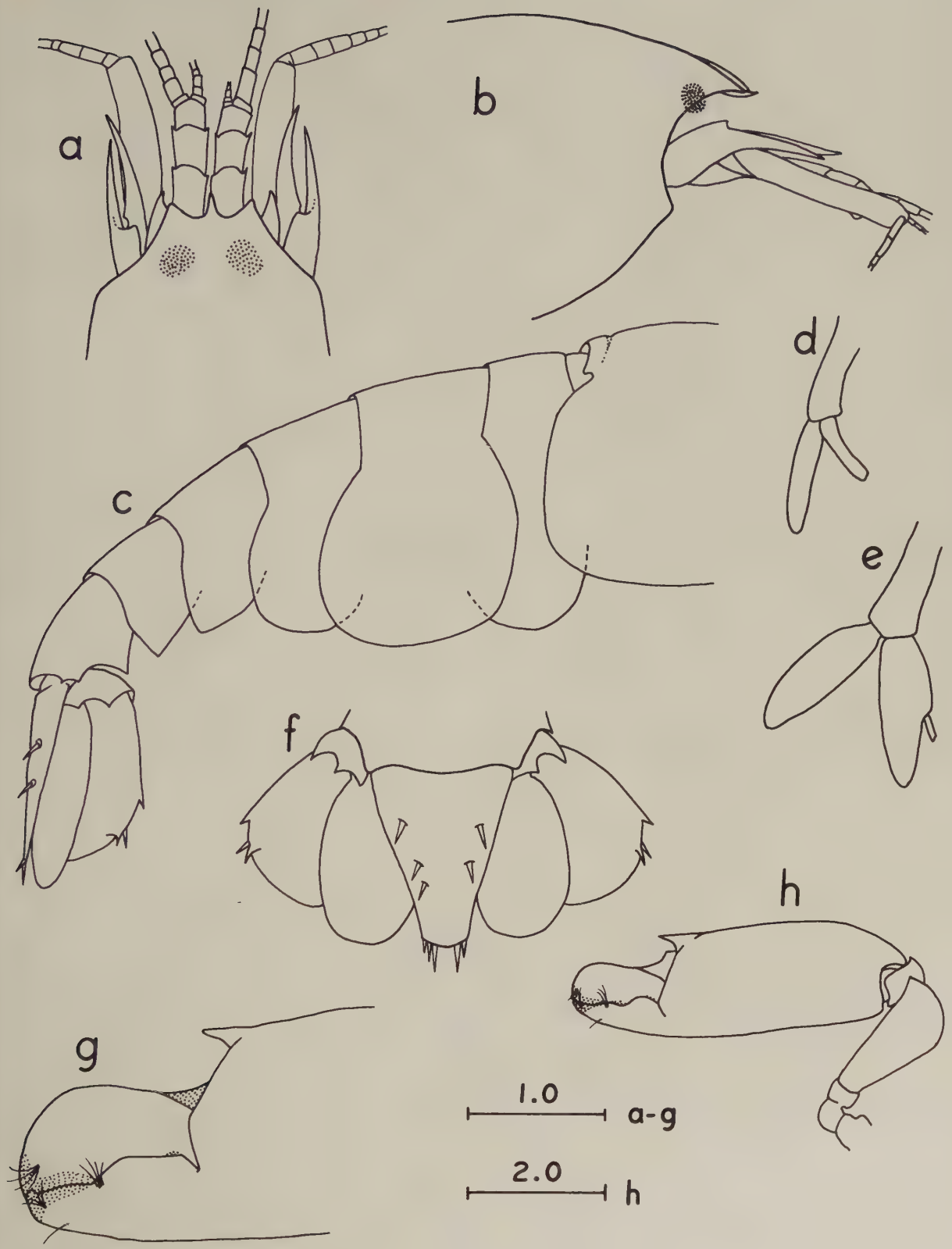

Figure 12. *Synalpheus brooksi*, ovigerous female, CL 5.0, USNM 189152; a. anterior region, dorsal view; b. anterior region, lateral view; c. abdomen; d. left pleopod 1; e. left pleopod 2; f. telson and uropods; g. left major chela, lateral view of distal portion; h. same, lateral view.

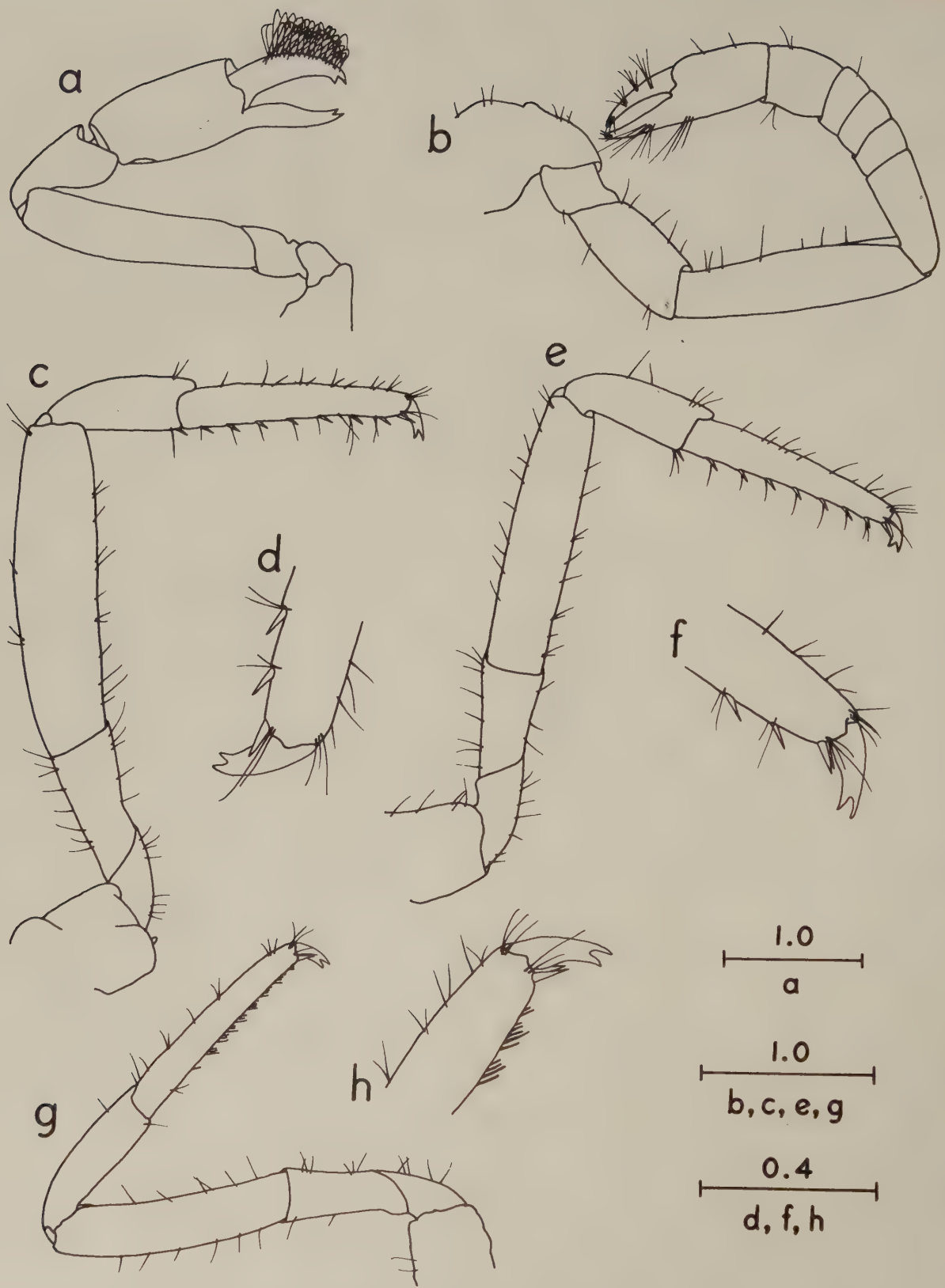

Figure 13. *Synalpheus brooksi*, ovigerous female, CL 5.0, USNM 189152; a. right minor chela; b. left pereopod 2; c. left pereopod 3; d. same, dactyl; e. left pereopod 4; f. same, dactyl; g. left pereopod 5; h. same, dactyl.

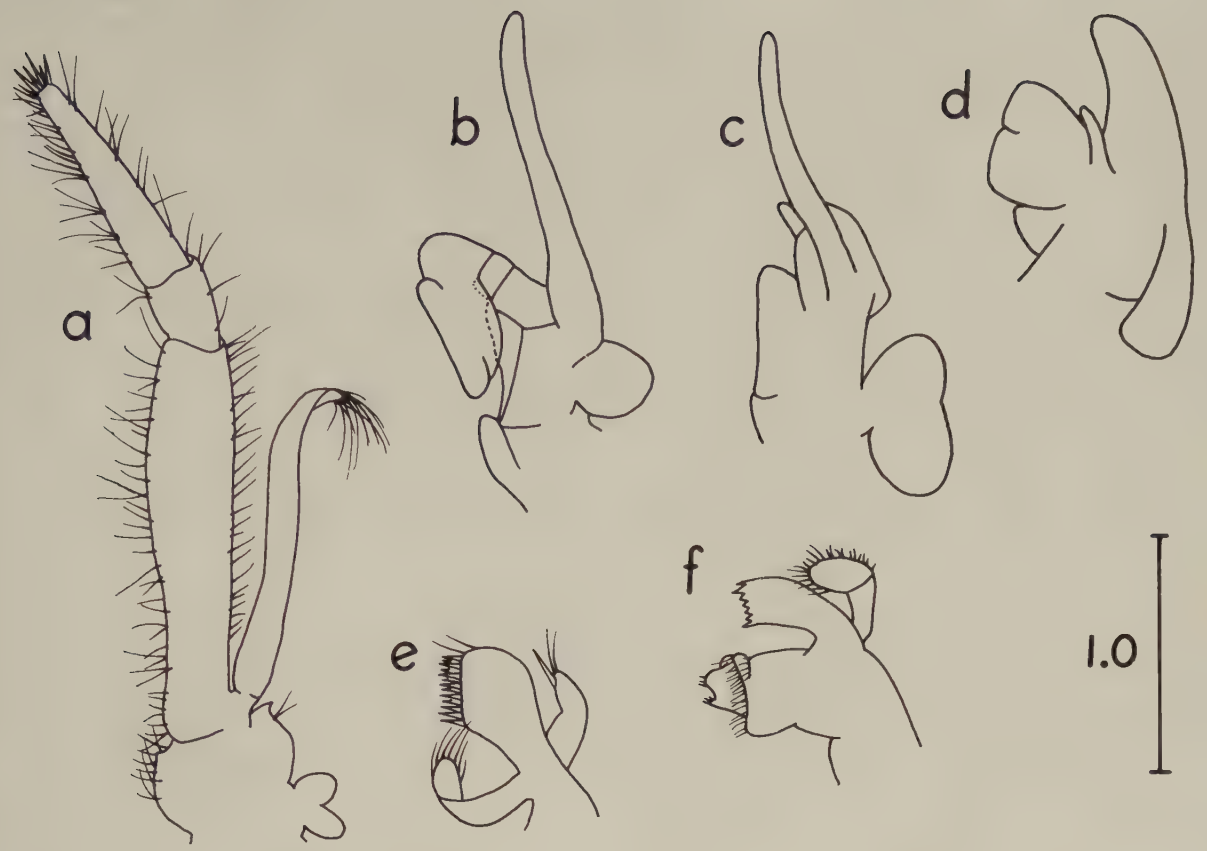

Figure 14. *Synalpheus brooksi*, ovigerous female, CL 5.0, USNM 189152; a. left maxilliped 3; b. left maxilliped 2; c. left maxilliped 1; d. left maxilla 2; e. left maxilla 1; f. left mandible.

Size (CL in mm): Adult males, 3.8-5.4; ovigerous females, 3.4-5.6; subadults with infertile eggs, 3.2-4.2; subadults without eggs, 3.1-3.9; juveniles, 1.4-3.1.

Habitat: Associated with sponges (Lyons et al., 1971; Chace, 1972), including *Spheciospongia vesparium* (Lamarck, 1814) (Coutière, 1910; McClendon, 1911; Pearse, 1932b; 1950; DeLaubenfels, 1936; Dobkin, 1965; Heard and Perlmutter, 1977; Westinga and Hoetjes, 1981), and *Spongia tubulifera* Lamarck, 1814, *Ircinia strobilina* Lamarck, 1816, and *Ircinia felix* Duchassaing and Michelotti, 1864 (Pearse, 1932b). Many of the specimens from the Florida Middle Ground were associated with *Agelas dispar*, but *S. brooksi* did not occur in *Agelas* from the Bahamas. Chace (1972) reported the species from coral rock, *Thalassia* flats, and among mangrove roots.

Lyons et al. (1971) reported *S. brooksi* from salinities ranging from 12 to 34°/∞ and from temperatures of 14 to 31°C. Hourglass specimens were collected from bottom salinities ranging from 32.3 to 36.5°/∞ and from bottom temperatures of 13.9 to 28.5°C. Florida Middle Ground specimens were collected from bottom salinities ranging from 34.6 to 36.2°/∞ and from bottom temperatures ranging from 17.1 to 26.0°C.

Distribution: Atlantic: Bahama Islands (Coutière, 1909; Pearse, 1950), Biscayne Bay

(Dobkin, 1965), Surinam (Holthuis, 1959), and Brazil (Coutière, 1909; Coelho and Ramos, 1972); Gulf of Mexico: Florida Keys (Coutière, 1909; Heard and Perlmutter, 1977), Dry Tortugas (Coutière, 1910; McClendon, 1911; Pearse, 1932), off central western Florida and Florida Middle Ground (present study), off Crystal River (Lyons et al., 1971), and off Cape San Blas (Coutière, 1909); Caribbean: Yucatan Peninsula (Coutière, 1909; Chace, 1972), Puerto Rico (Rathbun, 1901; Coutière, 1909), Virgin Islands (Coutière, 1909), Leeward Islands, Windward Islands, and Tobago (Chace, 1972), and Netherlands Antilles (Westinga and Hoetjes, 1981). Distributed bathymetrically from sublittoral (Chace, 1972) to 73 m (present study). Schmitt's (1935) statement that *S. brooksi* occurs to a depth of 168 fathoms (307 m) was unsubstantiated and probably an error.

Remarks: *Synalpheus brooksi* is one of three species confused under the names *S. laevimanus* var. *longicarpus* and *S. longicarpus* β by Coutière (1898; 1899).

The Puerto Rican specimens reported by Rathbun (1901) as *Synalpheus laevimanus longicarpus* (*Fish Hawk* Station 6095) and *S. l. parfaiti* (*Fish Hawk* Station 6085) were included by Coutière (1909) in his material of *S. brooksi*.

Christoffersen (1979) considered *S. bousfieldi*, *S. tanneri*, and *S. herricki* to be junior synonyms of *S. brooksi*. *Synalpheus tanneri* is actually a junior synonym of *S. herricki*, while *S. herricki* and *S. bousfieldi* are best retained as distinct species until the range of variation proposed by Christoffersen (1979) can be demonstrated in a large series of specimens. Although difficult to separate, adult specimens of each species can be distinguished by utilizing characters listed in Table 5 (p. 54).

Synalpheus herricki, particularly, can be quite difficult to separate from *S. brooksi*. Rouse (1970) probably confused these species in his faunal inventory of Florida Bay (see *Remarks* for *S. herricki*). Chace (1972) separated the species by the number of fixed teeth on the outer branch of the uropod and by the relative lengths of the scaphocerite and the lateral spine of the basicerite. Reexamination of the types of *S. herricki*, however, revealed that the dentition of the outer branch of the uropod of both species is identical. In addition, most specimens of *S. brooksi* examined have the lateral spine of the basicerite subequal to the scaphocerite, as does *S. herricki*. Coutière (1909) separated the two species by the differing lengths of the carpus relative to the chela of the minor pereopod. Although measurements by Coutière were sometimes unnecessarily precise, this remains the single best character which separates these species. *Synalpheus brooksi* has the carpus about 1/2 as long as the chela, whereas in *S. herricki*, the carpus is about 3/4 the length of the chela. Additionally, *S. brooksi* usually has the stylocerite broad, reaching about to the midpoint of the first antennular segment, and lateral margins of the telson are nearly straight; *S. herricki* has the stylocerite more slender, extending to the distal 1/4 of the first antennular segment, and lateral margins of the telson are concave in the posterior 1/4. Male *S. brooksi* are easily separated from male *S. herricki* by the subrectangular form of the ventral margin of the third abdominal pleuron in the former.

The above characters, however, must be used cautiously with immature specimens, as the extremes of variation in juveniles of the two species approach each other. Juveniles are best separated by the shape of the posterior margin of the telson, which is broadly V-shaped in *Synalpheus brooksi* and provided with a rounded median projection between the posterior spines in *S. herricki* (Figure 30a). This distinction is often obscured in adult specimens.

The relative lengths and widths of the appendages and their segments vary considerably in all species of *Synalpheus*. Coutière (1909) noted this variability and, lacking sufficient material to

determine its limits, often described subspecies based on a few specimens with anomalous features. This appears to have been the case with the two subspecies of *S. brooksi*. Both *Synalpheus brooksi strepsiceros* and *S. b. eleutherae* fall within the range of variability of typical *S. brooksi*.

I have examined the specimen reported as *Synalpheus* n. sp. by Lyons et al. (1971); it seems to be a fairly typical *S. brooksi*.

There is little reason to doubt reports of *S. brooksi* from off Brazil by Coutière (1909) and Coelho and Ramos (1972), but other Brazilian records are questionable. Many of Christoffersen's (1979) figures appear to be of *S. brooksi*, but, without examining his specimens, it is difficult to tell which of his records were actually for *S. herricki* or *S. bousfieldi*. The report of *S. longicarpus* (=*S. brooksi*?) by Corrêa (1972) is questionable for the same reason. Finally, Fausto-Filho and Sampaio Neto (1976) reported a juvenile specimen as *Synalpheus ?brooksi*.

The absence of *S. brooksi* from the western Gulf of Mexico is surprising and may be an artifact of sampling.

Dobkin (1965) reported that larval development of *S. brooksi* is direct, without a free-swimming stage. Westinga and Hoetjes (1981) speculated that the shrimp may complete its entire life cycle within the protection of a host sponge. McClendon (1911) noted a positive thigmotactic and a negative phototrophic response in *S. brooksi*, concomitant with its commensal habits.

Abundance, seasonality, and size structure of the population: Occurrence of *Synalpheus brooksi* in Hourglass collections made from December 1965 through November 1967 was analyzed for bathymetric distribution, reproductive patterns, and seasonal size structure. Despite the apparent patchy temporal and spatial distribution (Table 3) resulting from intermittent collection of the host sponges, several trends were discernable.

Population density was clearly greatest at Stations C and K, the 37 m stations (Figure 15). Joyce and Williams (1969) noted the abundance of large loggerhead sponges at these stations. Westinga and Hoetjes (1981) have demonstrated a preference of *S. brooksi* for large loggerheads

TABLE 3. MONTHLY CATCH OF *Synalpheus brooksi* AT HOURGLASS STATIONS.

Synalpheus brooksi

STA	1965					1966												1967											TOT
	A	S	O	N	D	J	F	M	A	M	J	J	J sp	A	S	O	N	D	J	J sp	F	M	A	M	J	J	A	S	O	N	
A																															
B_1							3																						4		7
B_2																															
C_1		1	2			2	5	5	6					1	2	1				27	1						8	1	16	1	79
C_2									7	2	66	11		5	259		1	2					2			19			4	1	379
D_1																				96	3										99
D_2									1																						1
E																				1							1				2
I																															
J																8															8
K	3		2			10		5		1		11	152	8	22	1	1		56	23	18	2	91			2		6		16	430
L													3		3				4					1							11
M																			1												1
TOT	3	1	4			12	8	10	14	3	66	22	155	14	286	10	2	2	61	147	22	2	93	1		21	9	7	24	18	1017

Subscripts 1, 2, and SP represent regular (night), post (day), and supplementary (45 ft trawl) cruises.

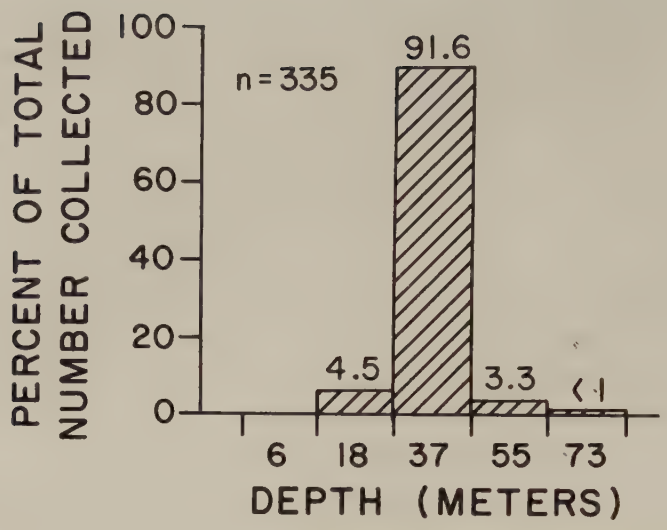

Figure 15. Relative abundance of *Synalpheus brooksi* by depth during regular (night) sampling at Hourglass stations. Dredge and trawl samples combined; 45-ft trawl catches omitted.

(> 2.5 1 volume). Although both *Spheciospongia* and *Synalpheus brooksi* are common in very shallow water in the Florida Keys (Heard and Perlmutter, 1977), apparently neither occurs at the shallowest Hourglass stations. Westinga and Hoetjes (1981) also found *S. brooksi* to be more abundant in sponges from about 50 m than from 3 m. Intermediate depths, however, were not sampled.

An extended breeding season is indicated by the continuous recruitment and the presence of ovigerous females during every month except December (Figure 16). Females larger than 4.0 mm CL were always ovigerous, and the male/female sex ratio of adults was very near unity (Figure 17). The apparent peaks in breeding activity in March, May, August, and November are artifacts of the small sample size. Seasonal influences on reproduction seemed to be negligible.

Coutière (1909) and Chace (1972) noted that some specimens of *S. brooksi* carry small, chalky, spherical objects attached to the pleopods. These objects, which both authors supposed to be infertile eggs, were present on specimens with male secondary sexual characteristics. Specimens with similar infertile eggs also occurred in both the Hourglass and Middle Ground collections. Only specimens intermediate in size between juveniles and adult specimens (3.2-4.2 mm CL) carried these eggs (Figure 16). Specimens in this size range, both with and without eggs, lack the secondary sexual characters present in adults, and are referred to herein as subadults. Those with infertile eggs are undoubtedly female, but the sex of non-ovigerous subadults is uncertain. Non-ovigerous subadults heavily outnumbered egg-bearing subadults, suggesting that at least some non-ovigerous subadults were female. Subadults comprised the most abundant size classes and are probably responsible for comments on the low fecundity of *S. brooksi* by Lyons et al. (1971). Subadults with infertile eggs probably occur year-round; none were collected in March, May, November, or December, but *S. brooksi* were scarce in samples taken during these months (Table 3).

Infertile eggs occur in a number of species of *Synalpheus* (Coutière, 1909; Felder, 1982). Possible causes of the condition are presented in a general discussion of reproduction in *Synalpheus* (p. 106).

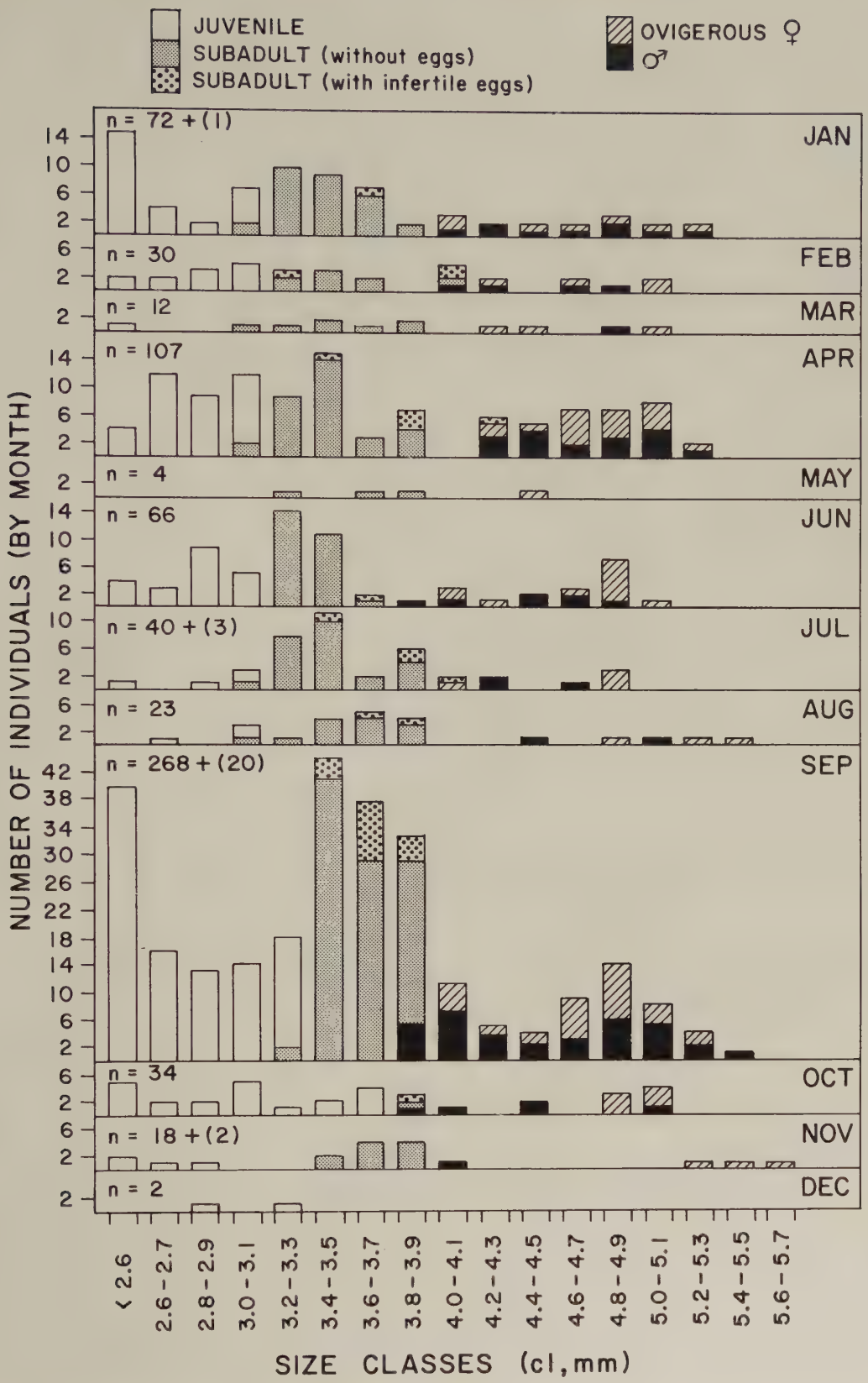

Figure 16. Size structure of population of *Synalpheus brooksi* at Hourglass stations. Monthly catches from December 1965 through November 1967 combined. Numbers in parentheses represent damaged, unmeasurable specimens.

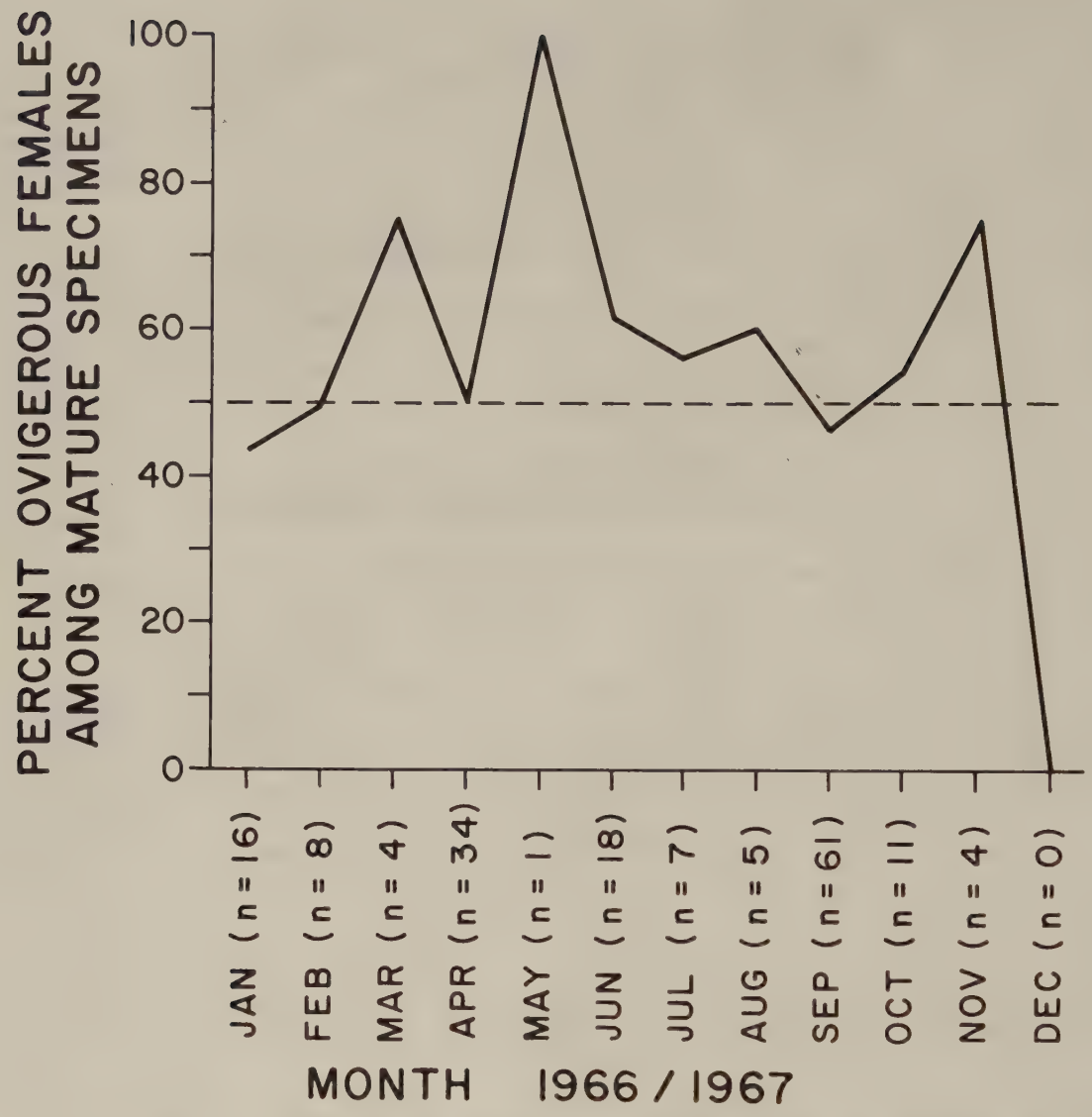

Figure 17. Percent normal ovigerous specimens among adult *Synalpheus brooksi* collected at Hourglass stations. Monthly catches from December 1965 through November 1967 combined.

Synalpheus disparodigitus Armstrong, 1949

Synalpheus disparodigitus Armstrong, 1949, pp. 17-20, fig. 6; Chace, 1972, p. 92.

Synalpheus paraneptunus: Chace, 1972, p. 103 [in part]. [Not *Synalpheus paraneptunus* Coutière, 1909].

Material examined: 7 ♂, 3.2-4.3; 5 ♀ (only 1 still with eggs, 4.4), 3.7-4.9; 1 juv., 2.6; Barahona Harbor, Dominican Republic; J. C. Armstrong (coll.); PARATYPES; AMNH 9576. — 1 ♂, 3.2; Carriacou, Grenadine Islands; 16 March 1956; Smithsonian-Bredin Station 16-56; USNM 136149. — 1 ovig. ♀, 3.4; Carriacou, Grenadine Islands; 16 March 1956; Smithsonian-Bredin Station 16-56; USNM 136269.

Diagnosis: Rostrum slender, equal to or longer than narrowly triangular ocular hoods, strongly convex ventrally. Pleuron of first abdominal somite of male bearing weak tooth posteriorly, that of second broadly rounded, those of third, fourth, and fifth subrectangular, that of sixth acuminate.

Telson broad anteriorly, narrow posteriorly, lateral margins slightly concave in posterior 1/4; dorsal surface armed with 2 pairs of spines situated at about 1/4 and 1/2 length. Stylocerite extending to distal 1/4 of first segment of antennal peduncle. Scaphocerite considerably overreaching lateral spine of basicerite, blade absent; basicerite not armed dorsally. Palm of major chela terminating dorsodistally in blunt tubercle armed secondarily with slender spine directed distally; fixed finger short, not reaching nearly as far distally as movable finger. Fingers of minor chela subequally bidentate distally, tips arranged in plane of chela, dense fringe of curved hairs present on extensor surface of dactyl; length of carpus slightly more than 1/2 that of chela. Carpus of pereopod 2 composed of 5 articles. Dactyls of posterior 3 pereopods with proximal tooth stronger than and slightly divergent from distal tooth. Lateral branch of uropod with 4-7, usually 6, teeth proximal to movable spine.

Habitat: From quiet water behind reef (Armstrong, 1949) and from seaward edge of exposed reef of dead *Porites* (Chace, 1972).

Distribution: Caribbean: From the Dominican Republic (Armstrong, 1949) and from Carriacou, Grenadine Islands (Chace, 1972); depths unknown.

Remarks: Chace (1972) inadvertently included an ovigerous female specimen of *S. disparodigitus* from Carriacou in his material and discussion of *S. paraneptunus*.

Chace (in litt.) has pointed out that, during the 1956 Smithsonian-Bredin Expedition, one of the growth forms of *Porites* was mistaken for *Pocillopora*. Accordingly, all references to the latter in his 1972 work have been changed herein to the former.

Synalpheus filidigitus Armstrong, 1949

Synalpheus filidigitus Armstrong, 1949, pp. 15-17, fig. 5; Chace, 1972, p. 92.

Material examined: 25 ♂, 2.1-2.4; 3 ovig. ♀, 2.5-2.9; 132 juv., 1.6-2.0; Barahona Harbor, Dominican Republic; J. C. Armstrong (coll.); PARATYPES; AMNH 9573.

Diagnosis: Rostrum narrower and usually longer than triangular ocular hoods, very weakly convex ventrally. Pleuron of first abdominal somite of male bearing blunt, hooked tooth posteriorly, those of fourth and fifth obscurely obtuse, that of sixth acuminate. Telson triangular, considerably narrower posteriorly than anteriorly, lateral margins nearly straight; dorsal surface divided into 3 subequal parts by 2 pairs of strong spines. Stylocerite narrowly acute, extending just beyond midpoint of first segment of antennular peduncle. Scaphocerite considerably exceeding lateral spine of basicerite, blade completely lacking; basicerite armed dorsally with stout spine. Palm of major chela terminating dorsodistally in rounded tubercle, armed secondarily with slender spine directed distoventrally. Fingers of minor chela simple, dactyl with fringe of curved hairs on extensor surface; length of carpus about 1/2 that of chela. Carpus of pereopod 2 composed of 4 articles; tips of fingers filiform. Dactyls of posterior 3 pereopods with proximal tooth slightly stronger than distal tooth. Lateral branch of uropod usually with 2 teeth proximal to movable spine.

Variation: Armstrong (1949) pointed out that the rostrum may be subequal to or shorter than the ocular hoods, the relative lengths of the scaphocerite and the lateral spine of the basicerite may vary, the dorsodistal tubercle of the major chela may be reduced, and the lateral margin of the uropod may have from one to three teeth proximal to the movable spine.

Habitat: Cavities of a sponge growing on *Porites* (Armstrong, 1949).

Distribution: Caribbean: Known only from the type-locality in Barahona Harbor, Dominican Republic, from an unknown depth (Armstrong, 1949).

Synalpheus goodei Coutière, 1909

Figures 18-21

Synalpheus laevimanus longicarpus: Verrill, 1900, p. 579; Rathbun, 1901, p. 110 [in part]. [Not *Alpheus laevimanus* Heller, 1862, =*Synalpheus gambarelloides* (Nardo, 1847); not *Alpheus saulcyi* var. *longicarpus* Herrick, 1891].

Synalpheus goodei Coutière, 1909, pp. 58-61, fig. 33; Verrill, 1922, pp. 64, 74, 116-121, figs. 5c, 6a, pl. 37, fig. 1, pl. 38, figs. 1, 2, pl. 39, fig. 4 [after Coutière, 1909], pl. 40, fig. 2; Schmitt, 1924a, p. 68; Chace, 1937a, p. 56; Gurney, 1949, pp. 293-295, figs. 1-9; Dobkin, 1969, p. 941; Chace, 1972, p. 93; Heck, 1977, p. 338; Felder and Chaney, 1979, p. 25; Rodriguez, 1980, pp. 162, 163; Markham and McDermott, 1981, p. 1270; Westinga and Hoetjes, 1981, pp. 141-147.

Synalpheus osburni Schmitt, 1933, pp. 1-3, fig. 1; 1935, p. 149, fig. 17 [after Schmitt, 1933]; Chace, 1972, p. 102.

Material examined: HOURGLASS STATION B: 1 ♂, 4.8; 1 ovig. ♀, 5.4; 20 October 1965; dredge; FSBC I 28376. — 1 ovig. ♀, 6.6; 19 November 1965; trawl; FSBC I 28377. — 1 ♂, 5.1; 1 ovig. ♀, 6.2; 7 February 1966; trawl; FSBC I 28378. — 1 ♂, 5.2; 1 ovig. ♀, 6.4; 15 April 1966; dredge; FSBC I 28379. — 1 ♂, 5.4; 1 ovig. ♀, 6.8; 6 June 1966; trawl; FSBC I 28380. — 1 ovig. ♀, 5.1; 10 July 1966; trawl; FSBC I 28381. — 3 ♂, 3.9-5.3; 2 ovig. ♀, 4.7, 5.9; 18 July 1966; trawl; USNM 189154. — 1 ovig. ♀, 5.9; 1 August 1966; trawl; FSBC I 28382. — 1 ♂, 4.7; 10 August 1966; dredge; FSBC I 28383. — 1 juv., 2.9; 18 October 1966; trawl; FSBC I 28384. — 1 ♂, 4.5; 2 March 1967; dredge; FSBC I 28385. — 1 ♂, 4.9; 14 March 1967; dredge; FSBC I 28386. — 1 ♂, 4.4; 3 April 1967; dredge; FSBC I 28387. — 2 ♂, 4.4, 5.9; 1 ovig. ♀, 7.3; 1 juv., 2.9; 20 May 1967; dredge; FSBC I 28388. — 2 ♂, 4.5, 5.1; 2 ovig. ♀, 5.2, 5.7; 2 June 1967; dredge; FSBC I 28389. — 1 ♂, 4.4; 1 ovig. ♀, 4.5; 25 October 1967; dredge; USNM 189153. — HOURGLASS STATION C: 1 ovig. ♀, 5.3; 27 March 1966; dredge; FSBC I 28390. — 1 ovig. ♀, 6.2; 1 August 1966; dredge; FSBC I 28391. — 1 ovig. ♀, 4.1; 19 November 1966; dredge; FSBC I 28392. — 1 ovig. ♀, 5.3; 1 December 1966; dredge; FSBC I 28393. — 1 ♂, 4.3; 6 January 1967; dredge; FSBC I 28394. — 1 ovig. ♀, 5.8; 27 February 1967; trawl; FSBC I 28395. — 1 ♂, 4.6; 2 ovig. ♀, 5.0, 5.9; 11 September 1967; dredge; FSBC I 28396. — 1 ♂, 4.7; 21 November 1967; dredge; FSBC I 28397. — HOURGLASS STATION D: 1 ♂, 4.7; 3 August 1965; dredge; FSBC I 28398. — 1 ovig. ♀, 6.4; 20 November 1965; trawl; FSBC I 28399. — HOURGLASS STATION J: 1 ovig. ♀, 5.5; 5 August 1966; dredge; FSBC I 28400. — 1 juv., 3.1; 6 December 1966; dredge; FSBC I 28401. — 1 ovig. ♀, 5.3; 12 January 1967; dredge; FSBC I 28402. — 2 ♂, 4.5, 5.1; 1 ovig. ♀, 4.9; 30 January 1967; trawl; FSBC I 28403. — 1 ♂, 4.5; 1 ovig. ♀, 5.0; 8 March 1967; dredge; FSBC I 28404. — HOURGLASS STATION L: 1 ♂, 5.3; 4 September 1965; trawl; FSBC I 28405. — 1 ♂, 5.3; 13 June 1966; trawl; FSBC I 28406. — 1 juv., 3.5; 5 September 1966; trawl; FSBC I 28407. — 1 ♂, 5.2; 1 ovig. ♀, 4.4; 2 juv., 2.5, 3.6; 5 September 1966; dredge; FSBC I 28408. — 3 juv., 2.5-3.8; 6 July 1967; trawl; FSBC I 28409. — 1 juv., 2.8; 5 September 1967; trawl; FSBC I 28410. — HOURGLASS STATION M: 1 ♂, 5.0; 13 June 1966; trawl; FSBC I 28411. — 2 ovig. ♀, 4.6, 5.9; 6 August 1966; dredge; FSBC I 28412. — 1 ♀ (with hemiarthrine), 3.4; 5 September 1966; dredge; FSBC I 23886. — 1 ovig. ♀, 5.5; 2 juv., 2.5, 2.7; 5 September 1966; dredge; FSBC I 28413. — 2 juv., 2.8, 2.8; 13 October 1966; dredge; FSBC I 28414. — 1 juv., 3.0; 13 November 1966; trawl; FSBC I 28415. — 1 ovig. ♀, 4.5; 7 December 1966; trawl; FSBC I 28416. — 1 ovig. ♀, 4.6; 16 February 1967; trawl; FSBC I 28417. — 1 ♂, 4.2; 1 damaged adult, 4.6; 1 juv., 3.2; 9 March 1967; dredge; FSBC I 28418. — 1 ♂, 5.1; 8 April 1967; trawl; FSBC I 28419. — 1 juv., 2.9; 16 May 1967; trawl; FSBC I 28420. — 2 ♂, 4.8, 5.4; 2 ovig. ♀, 5.9, 6.2; 6 July 1967; trawl; FSBC I 28421. — 2 ♂, 4.5, 4.8; 2 ovig. ♀, 4.7, 5.0; 1 juv., 2.9; 8 August 1967; trawl; FSBC I 28422. — 1 ovig. ♀, 4.6; 3 juv. (1 damaged), 2.9, 3.1; 15 November 1967; dredge; FSBC I 28423. — FMG STATION 151: 2 ♂, 4.6, 4.7; 2 ovig. ♀, 5.1, 5.4; 26-27 m; 5

October 1978; *Madracis decactis*; MESC 6179-2162. — 1 ♂, 5.4; 1 ovig. ♀, 5.5; 32 m; 28 June 1979; *Agelas dispar*; MESC 6179-2163. — 1 juv., 3.0; 26 m; 29 June 1979; *Haliclona* sp.; MESC 6179-2164. — FMG STATION 247: 1 ♂, 4.5; 30 m; 13 October 1978; *Madracis decactis*; MESC 6179-2165. — FMG STATION 481: 1 ♂, 4.9; 29 m; 7 October 1978; *Madracis decactis*; MESC 6179-2166. — FMG STATION 492: 1 ♂, 4.8; 1 ovig. ♀, 5.3; 27-34 m; 5 July 1979; *Madracis decactis*; MESC 6179-2167. — 1 ♂, 5.0; 30 m; 6 July 1979; reef rubble; MESC 6179-2168. —OTHER MATERIAL: 1 ♂, 4.4; 1 ovig. ♀, 5.1; Ewing Bank; 28°06'N, 91°00'W; 55 m; 11 September 1977; submersible; TAMU 2-6246. — 37 ♂, 3.7-5.5; 18 ovig. ♀, 4.9-6.8; 3 juv., 1.8-2.9; Bermuda; G. Brown Goode (coll.); SYNTYPES; USNM 24821. — 1 ovig. ♀, 5.2; near Guayanilla Harbor, Puerto Rico; 25 June 1915; Raymond C. Osburn (coll.); HOLOTYPE of *S. osburni*; AMNH 3599.

Diagnosis: Rostrum (Figures 18a, 21b) slender, distinctly longer than narrowly triangular ocular hoods, strongly convex ventrally. Pleuron of first abdominal somite of male (Figure 21c) bearing hooked tooth posteriorly, that of second with obtuse projection posteriorly, those of third and fourth subrectangular, that of fifth narrowly rounded, that of sixth acuminate. Telson (Figures 18b, 21f) broad anteriorly, considerably narrower posteriorly, with lateral margins distinctly concave in posterior 1/4; surface divided into 3 subequal parts by slender but prominent dorsal spines, strongly elevated from plane of telson. Stylocerite (Figures 18a, 21b) extending nearly to distal margin of first segment of antennular peduncle. Scaphocerite considerably longer than lateral spine of basicerite; basicerite angulate dorsally. Palm of major chela (Figure 18f, g) terminating distodorsally in blunt tubercle, secondarily armed with slender spine directed distoventrally. Dactyl of minor chela (Figures 19a, 21g) with 2 distinct teeth and obscure rectangular cant distally, all situated perpendicular to plane of finger, and dense fringe of curved hairs on extensor surface; obscure cant mesial and slightly posterior to well-defined distal tooth of fixed finger; length of carpus about 0.45 that of chela. Carpus of pereopod 2 (Figure 19b) composed of 5 articles. Dactyls of posterior 3 pereopods (Figure 19d, f, h) with proximal tooth shorter than and slightly divergent from distal tooth. Lateral branch of uropod (Figures 18b, 21f) usually with 6-10 fixed teeth proximal to movable spine.

Variation (also see *Remarks*): Variation in the number of uropodal teeth proximal to the movable spine is pronounced, ranging from 4 to 12 in adults and from 4 to 7 in juveniles. Adults most frequently have 6 to 10 teeth per uropod, excluding the movable and sutural spines. Generally, fewer teeth are present in juveniles. Several adults, normal in other respects, have an extra movable spine on one or both uropods.

The frontal region is also subject to variation. The rostrum is rarely subequal in length to the ocular hoods (Figure 21b), usually extending beyond them by 1/4 its length (Figure 18a), and occasionally overreaching them by 1/2 its length. The ocular hoods are typically slender and rather acute but are sometimes broad and obtuse.

Had Coutière (1909) described an "oxyceros" form of *S. goodei*, most of the material reported herein would correspond to it. The prolongation characteristic of this form is not necessarily restricted to the scaphocerite. The lateral spine of the basicerite, as well as the stylocerite and rostrum, are often longer relative to the antennules and the distal segment of the antennal peduncle than in the typical form.

An occasional specimen has the lateral spine of the basicerite longer than the scaphocerite. These usually can be distinguished from *S. pandionis* by the acute dorsal process of the basi-

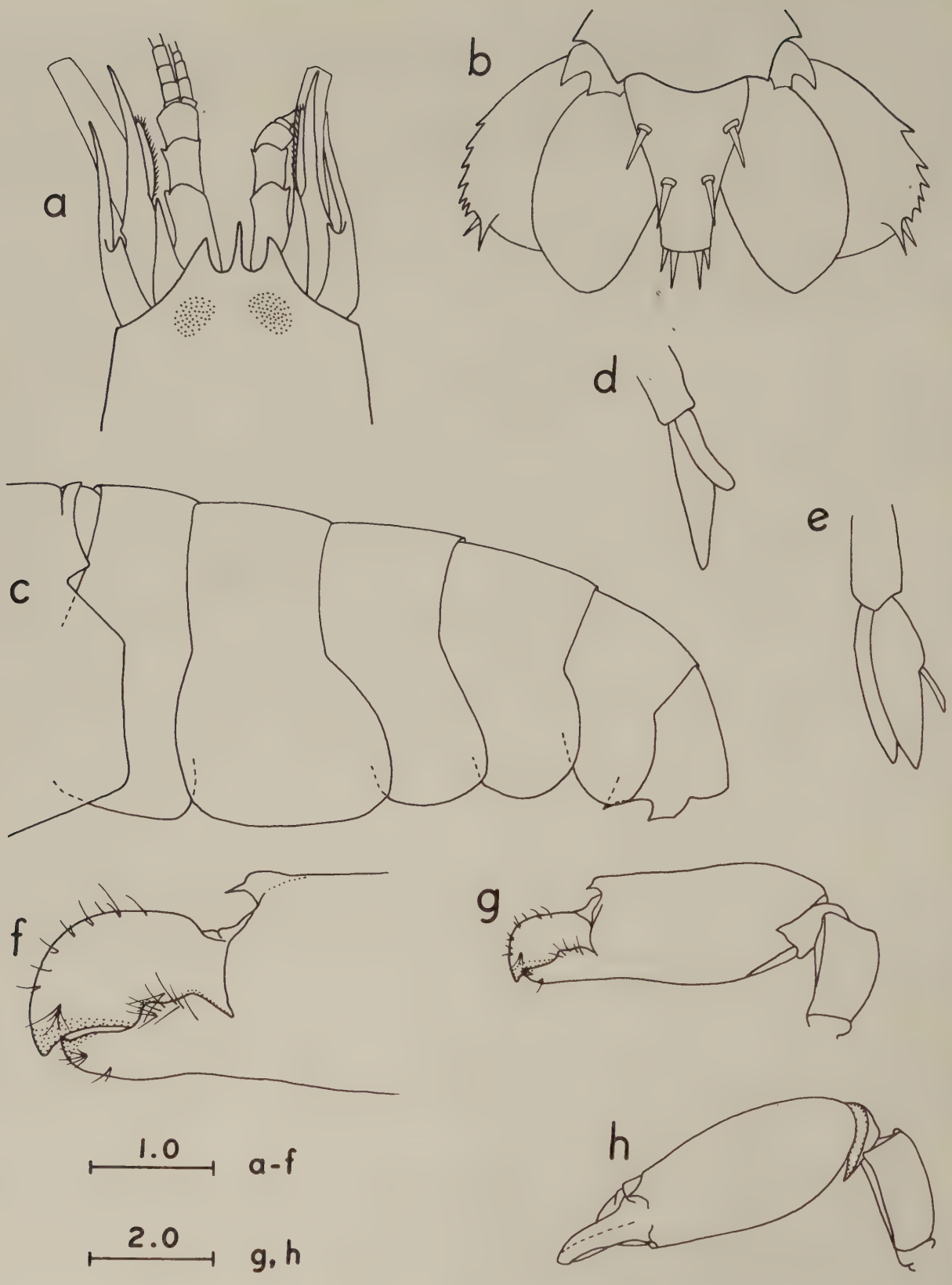

Figure 18. *Synalpheus goodei*, ovigerous female, CL 4.5, USNM 189153; a. anterior region, dorsal view; b. telson and uropods; c. abdomen; d. left pleopod 1; e. left pleopod 2; f. left major chela, lateral view of distal region; g. same, lateral view; h. same, dorsal view.

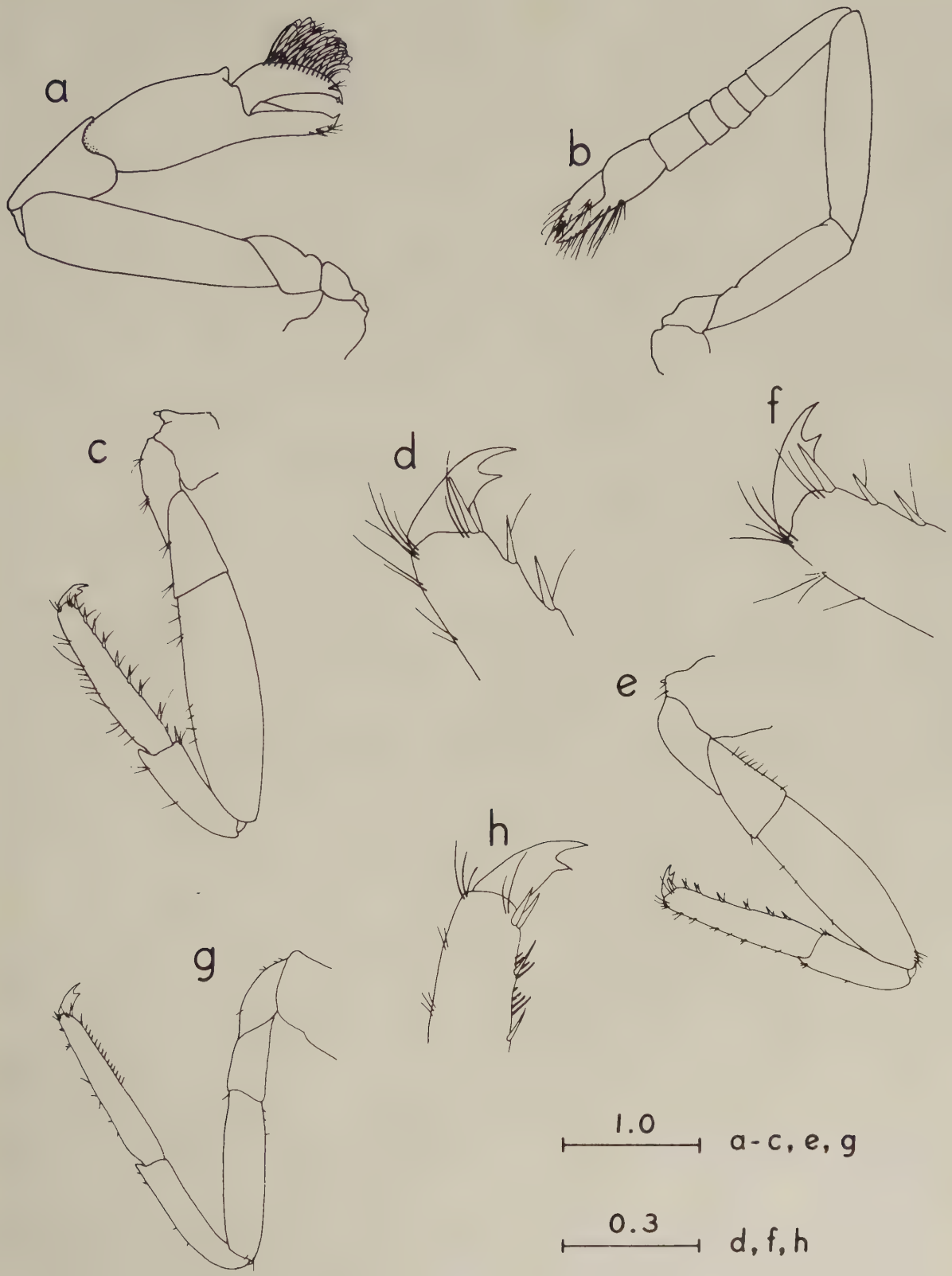

Figure 19. *Synalpheus goodei*, ovigerous female, CL 4.5, USNM 189153; a. right minor chela; b. left pereopod 2; c. left pereopod 3; d. same, dactyl; e. left pereopod 4; f. same, dactyl; g. left pereopod 5; h. same, dactyl.

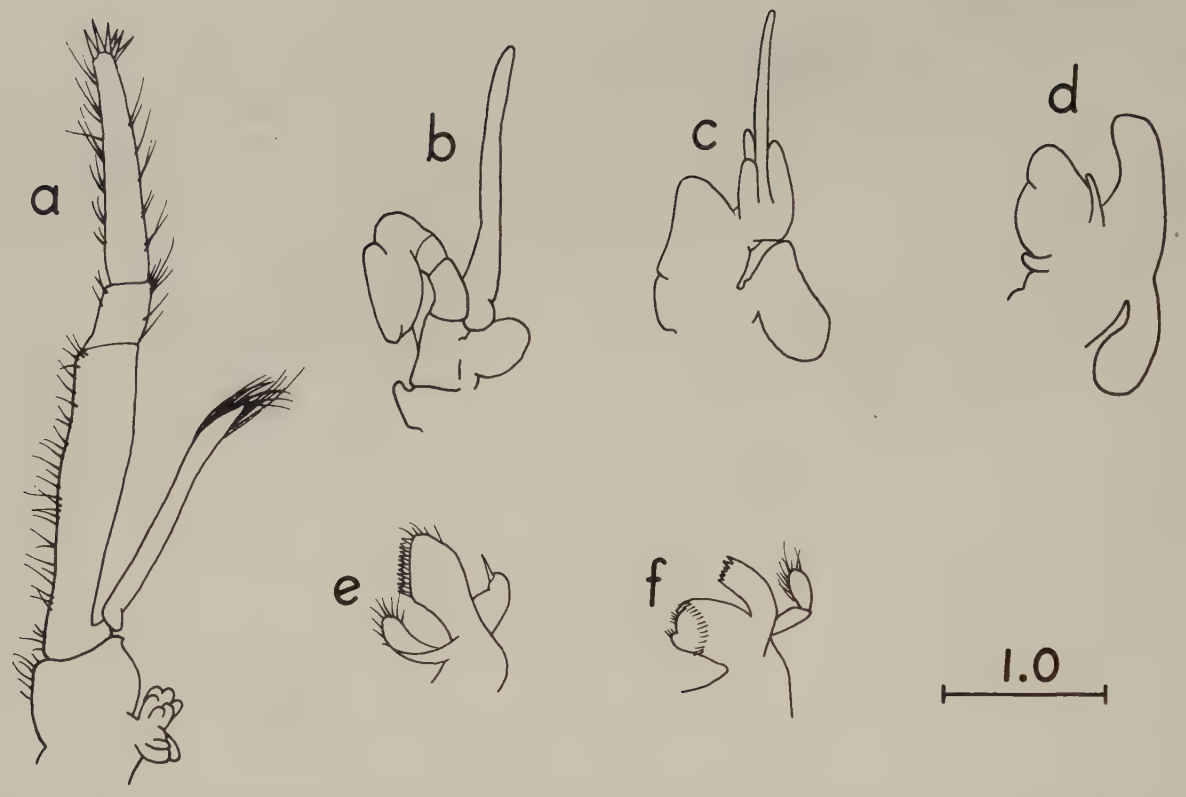

Figure 20. *Synalpheus goodei*, ovigerous female, CL 4.5, USNM 189153; a. left maxilliped 3; b. left maxilliped 2; c. left maxilliped 1; d. left maxilla 2; e. left maxilla 1; f. left mandible.

cerite and by the dentition of the fingers of the minor chela (see Table 8, p. 87). Care and some judgment are called for, since ranges of the two species are nearly identical.

Color: Body light red, deep pink, or pale, with minute chromatophores on a pale translucent ground-color, usually brighter red in median dorsal line; ovaries greenish; major chela pink with light brown tips (after Verrill, 1922).

Size (CL in mm): Males, 3.7-5.9; ovigerous females, 4.1-7.3; juveniles, 2.5-3.8.

Habitat: In sponges (Verrill, 1922; Gurney, 1949), including *Spheciospongia vesparium* (Westinga and Hoetjes, 1981), *Haliclona* sp. and *Agelas dispar* (present study); associated with coral (Chace, 1972), including *Siderastrea* and *Porites furcata* Lamarck, 1816 (Schmitt, 1924a), in reef rubble and *Madracis decactis* (present study), and in *Phyllochaetopterus* fouling mat (Felder and Chaney, 1979). Hourglass specimens were collected from bottom temperatures ranging from 13.9 to 30.0°C and from bottom salinities of 33.0 to 36.7°/∞. Ranges of the same parameters for Florida Middle Ground specimens were 22.0 to 26.0°C and 34.6 to 36.2°/∞.

Distribution: Atlantic: Bermuda (Verrill, 1900, 1922; Rathbun, 1901; Coutière, 1909; Chace, 1937a; Gurney, 1949; Markham and McDermott, 1981); Gulf of Mexico: Tampa Bay and off western Florida (Coutière, 1909), off eastern Texas (Felder and Chaney, 1979); Caribbean: Puerto Rico (Schmitt, 1933), Leeward Islands and Tobago (Chace, 1972), Netherlands Antilles (Schmitt, 1924a; Westinga and Hoetjes, 1981), and off Panama (Coutière, 1909; Heck, 1977). Distributed bathymetrically from intertidal depths (Chace, 1972) to 73 m (present study).

Remarks: Bermudian specimens reported by Verrill (1900) and by Rathbun (1901) as *Synalpheus laevimanus longicarpus* were included by Coutière (1909) in his material of *S. goodei.*

The antennal blade, typically long and narrow, is much shorter in a few specimens, and often wider. It is entirely absent in a male from the Florida Middle Ground, casting considerable doubt on the validity of *Synalpheus osburni* Schmitt, 1933. No other substantive differences between the two species are evident.

The syntypic material for the subspecies *S. goodei occidentalis* described from the Gulf of California by Coutière (1909), will probably prove to contain two separate species, each distinct from *S. goodei.* Coutière's (1909) Figure 34a shows a specimen with the stylocerite considerably exceeding the first antennular segment, a characteristic described only for *S. macclendoni* and *S. paraneptunus* among the Gambarelloides species of *Synalpheus.* Neither this specimen nor the one depicted in Figure 34a' have the dorsal surface of the basicerite produced to the extent found in typical *S. goodei.*

Gurney (1949) described and illustrated three larval stages of *S. goodei.* Stage I seems to be analogous to the "pseudo-larvae" of *S. brooksi* described by Dobkin (1965). Stage III is the immediate precursor of the postlarval form. Differences between the three stages are minor, and larval development is rapid, lasting "only a few days" (Gurney, 1949: 295).

Synalpheus goodei appears to be an uncommon species in the Gulf of Mexico, occurring only in small numbers (Felder and Chaney, 1979; Table 4; FMG data). Only two authors have reported this species as abundant. Verrill (1922) remarked that *S. goodei* was the most common species of *Synalpheus* at Bermuda within the cavities of sponges. Westinga and Hoetjes (1981) noted as many as 419 individuals in a single specimen of *Spheciospongia vesparium* from the Netherlands Antilles. Although this sponge is common in certain habitats in the Gulf of Mexico, *S. goodei* has not previously been reported as an associate, despite at least one study of the sponge's cryptofauna (Pearse, 1932b).

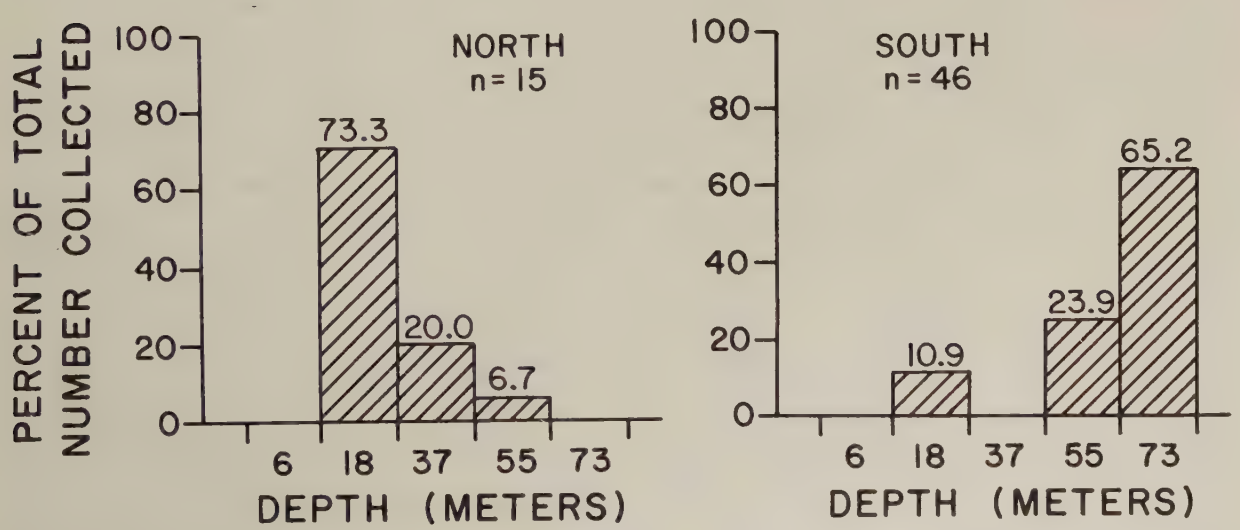

Figure 22. Relative abundance of *Synalpheus goodei* by depth at Hourglass stations on north and south transects during regular (night) sampling. Dredge and trawl samples combined; 45-ft trawl catches omitted.

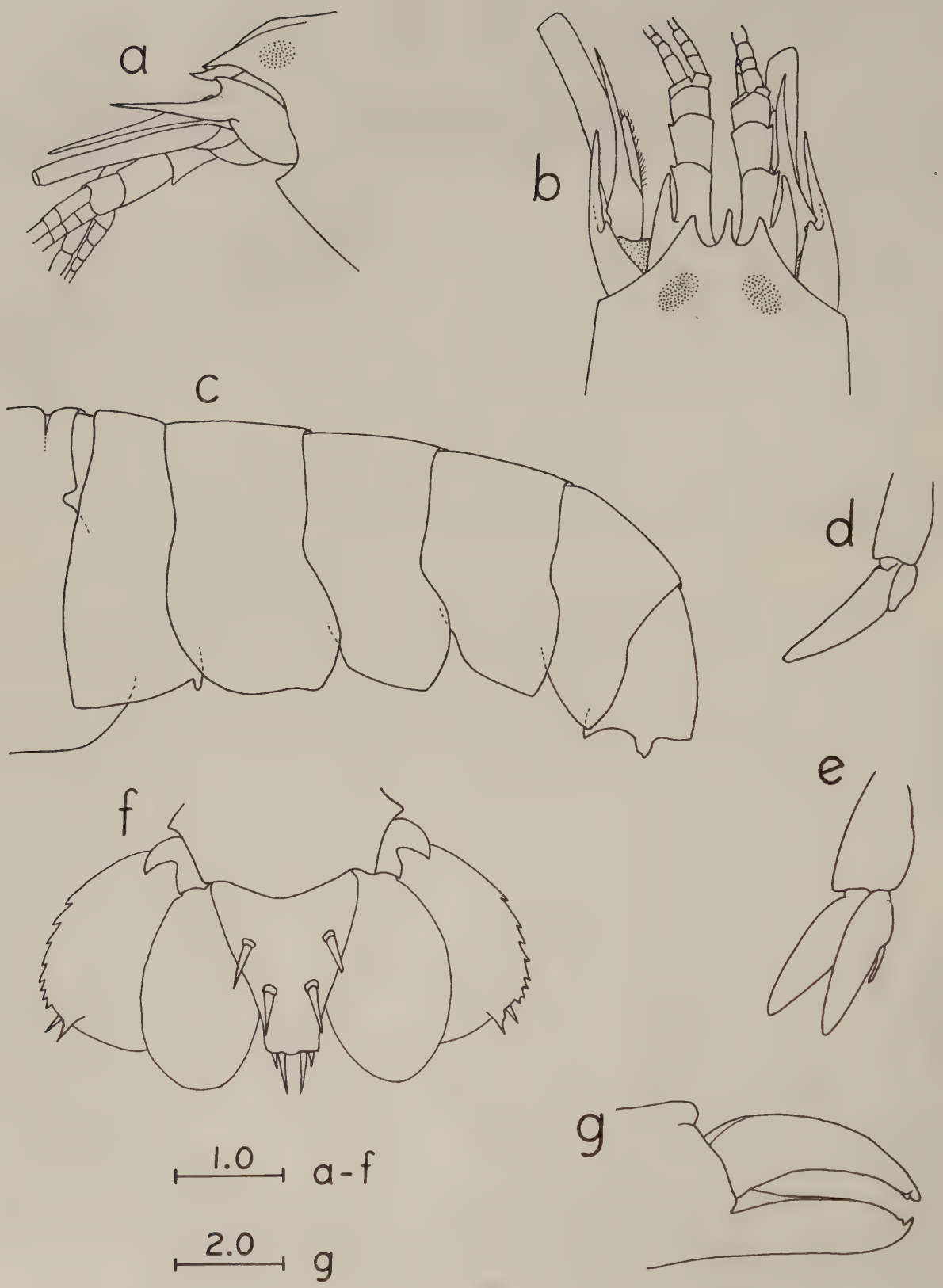

Figure 21. *Synalpheus goodei*, male, CL 5.3, USNM 189154; a. anterior region, lateral view; b. same, dorsal view; c. abdomen; d. left pleopod 1; e. left pleopod 2; f. telson and uropods; g. right minor chela, distal portion (setae omitted).

TABLE 4. MONTHLY CATCH OF *Synalpheus goodei* AT HOURGLASS STATIONS.

Synalpheus goodei

STA	1965					1966													1967											TOT
	A	S	O	N	D	J	F	M	A	M	J	J	J sp	A	S	O	N	D	J	J sp	F	M	A	M	J	J	A	S	O	N	
A																															
B_1							2				2		5	1								1	1		4						16
B_2			2	1					2			1		1		1						1		4					2		15
C_1														1				1	1												3
C_2								1									1				1							3		1	7
D_1	1																														1
D_2				1																											1
E																															
I																															
J														1				1	1	3		2									8
K																															
L		1									1				5											3		1			11
M											1			2	4	2	1	1			1	3	1	1		4	5			4	30
TOT	1	1	2	2			2	1	2		4	1	5	6	9	3	2	3	2	3	2	7	2	5	4	7	5	4	2	5	92

Subscripts 1, 2, and SP represent regular (night), post (day), and supplementary (45 ft trawl) cruises.

Synalpheus goodei was approximately three times more abundant on the southern transect than on the northern transect of the Hourglass cruise pattern. The dissimilar intertransect modal depth distribution (Figure 22) is similar to that of *S. pandionis*, and may reflect a specific habitat preference. Specimens were collected only from the four outermost station pairs (Table 4).

Males were about as abundant as females in the Hourglass study area (33:37). With the exception of a single parasitized specimen, all females collected were ovigerous. Egg-bearing females were collected during each month and were most numerous during August and September. Juveniles were present in March, May, and July through December. Year-round breeding is evident.

Synalpheus heardi new species

Figures 23-26

Material examined: HOLOTYPE: 1 ♂, 5.5; Florida Middle Ground; 28°36'N, 84°16'W; 30-34 m; 30 June 1976; diver-collected; *Ircinia* sp.; USNM 189155. — PARATYPES: 3 ♂, 6.5-6.8; 4 ovig. ♀, 5.4-7.1; 1 juv., 4.4; Florida Middle Ground; 28°36'N, 84°16'W; 30-34 m; 30 June 1976; diver-collected; *Ircinia* sp.; USNM 189156. — 9 ♂, 5.8-7.9; 10 ovig. ♀, 6.6-8.7; 1 damaged, 7.2; Florida Middle Ground; 28°32'N, 84°19'W; 30-34 m; 20 February 1976; diver-collected; *Ircinia campana*; USNM 189157. — 1 ♂, 6.7; 1 ♀ (with hemiarthrine), 7.7; 1 ovig. ♀, 6.7; HOURGLASS STATION M; 28 March 1978; dredge; FSBC I 28424. — OTHER MATERIAL: 5 ♂, 2.0-2.6; 3 ovig. ♀, 2.9-3.3; 2 juv., 1.3, 1.8; Freeport, Grand Bahama Island; 21-23 m; November 1975; diver-collected; *Agelas dispar*; MESC 6179-2169. — 1 ♂, 5.4; 2 ♀ (1 with infertile eggs, 2.2), 2.4; Freeport, Grand Bahama Island; 21-23 m; November 1975; diver-collected; *Agelas dispar*; MESC 6179-2170. — 2 juv., 2.0, 2.1; Freeport, Grand Bahama Island; 21-23 m; November 1975; diver-collected; *Agelas dispar*; MESC 6179-2171. — 1 ♀ (with infertile eggs), 2.2; 1 juv., 2.0; Freeport, Grand Bahama Island; 21-23 m; November 1975; diver-collected; *Agelas dispar*; MESC 6179-2172. — 4 ♂, 2.2-2.5; 1 ovig. ♀, 2.8; 1 juv., 1.6; Freeport, Grand Bahama Island; 21-23 m; November 1975; diver-collected; *Agelas dispar*; MESC 6179-2173. — 1 ♂, 2.8; 1 ovig. ♀, 2.9; Freeport, Grand Bahama Island; 21-23 m; November 1975; diver-collected;

Agelas dispar; MESC 6179-2174. — 4 ♂, 2.2-2.6; 1 ovig. ♀, 2.8; Freeport, Grand Bahama Island; 21-23 m; November 1975; diver-collected; *Agelas dispar*; USNM 189158. — 2 ♂, 2.2, 2.2; 1 ♀ (with infertile eggs), 2.2; 2 juv., 1.5, 1.7; Freeport, Grand Bahama Island; 21-23 m; November 1975; diver-collected; *Agelas dispar*; MESC 6179-2175. — 2 ♂, 2.3, 2.4; 1 ovig. ♀, 2.7; Freeport, Grand Bahama Island; 21-23 m; November 1975; diver-collected; *Agelas dispar*; MESC 6179-2176. — 3 ♂, 2.5-2.6; 4 ovig. ♀, 2.6-2.9; 1 juv., 1.7; Freeport, Grand Bahama Island; 21-23 m; November 1975; diver-collected; *Agelas dispar*; USNM 189159.

Diagnosis: Rostrum (Figures 23a, 26a) triangular, subequal in length to broadly triangular ocular hoods, very weakly convex ventrally. Pleuron of first abdominal somite of male (Figure 23d) bearing hooked tooth posteriorly, those of second and third broadly rounded, those of fourth and fifth subrectangular, that of sixth acuminate. Telson (Figures 23b, 26b) considerably narrower posteriorly than anteriorly, lateral margins nearly straight; anterior pair of dorsal spines arising from midlength of segment, posterior pair situated about 1/3 distance between anterior pair and posterior margin. Stylocerite (Figures 23a, 26a) reaching to about distal 1/4 of first segment of antennular peduncle. Scaphocerite considerably exceeding lateral spine of basicerite, blade absent; basicerite not armed dorsally. Palm of major chela (Figure 25a, b) broad, usually terminating distodorsally in single sharp spine. Fingers of minor chela (Figures 25d, 26d) deeply bidentate, tips arranged in plane of chela, dense fringe of curved hairs present on extensor surface of dactyl; length of carpus ranging from 1/2 to 3/4 that of chela. Carpus of pereopod 2 (Figure 24h) composed of 4 or 5 articles. Dactyls of posterior 3 pereopods (Figure 25e-g) with proximal tooth stronger than and slightly divergent from distal tooth. Lateral branch of uropod (Figures 23b, 26b) usually with single tooth proximal to movable spine.

Description: Rostrum (Figures 23a, 26f) triangular, subequal in length to ocular hoods, very weakly convex ventrally, without true ventral process. Broadly triangular ocular hoods separated from rostrum by shallow sinuses. Pterygostomial angle of carapace (Figure 23c) slightly produced as obtuse lobe.

Pleura of first, third, and fourth abdominal somites of female (Figure 26e) subrectangular, those of second and fifth rounded, that of sixth acuminate. Pleuron of first somite of male (Figure 23d) bearing small, hooked tooth posteriorly, those of second and third broadly rounded, those of fourth and fifth subrectangular, that of sixth acuminate. Telson (Figure 23b) triangular, considerably broader anteriorly than posteriorly, lateral margins almost straight; anterior pair of dorsal spines arising from midlength of segment, posterior pair situated about 1/3 distance between anterior pair and posterior margin; posterior margin armed with 2 pairs of unequal spines.

Stylocerite (Figures 23a, 26f) acute, extending to about distal 1/4 of first segment of antennular peduncle. Segments of antennular peduncle elongate; first subequal to second, both longer than third.

Scaphocerite reaching at least to midpoint of segment 2 of antennular peduncle; blade absent. Basicerite neither armed nor angulate dorsally; length of lateral spine variable, at least 1/2 length of and usually 3/4 length of scaphocerite; carpocerite of both sexes about 6 times as long as broad, barely overreaching antennular peduncle.

Mouthparts as figured (Figure 24a-g). Mandible with 7 marginal teeth on incisor process. Palp of maxilliped 1 consisting of 2 segments. Maxilliped 3 extending distinctly beyond antennal peduncle; exopod falling slightly short of distal margin of antepenultimate segment.

Major pereopod 1 (Figure 25a, c) overreaching antennal peduncle by nearly entire length of chela; chela usually stout, 3 times as long as broad, not noticeably twisted; fingers (Figure 25b) about 1/3 as long as palm, dactyl strongly hooked; palm terminating in single stout, acute spine directed distodorsally; carpus very short and broad; merus unarmed, 3/4 length of palm. Chela of minor pereopod 1 (Figure 25d) about 2 1/2 times as long as broad; fingers deeply bidentate; dactyl with dense fringe of curved hairs on extensor surface; length of carpus 3/4 that of chela. Pereopod 2 (Figure 24h) overreaching antennal peduncle by length of chela; fingers slightly longer than palm; carpus 2 times as long as chela, composed of 5 articles, proximal article subequal to combined lengths of distal 4, second, third, and fourth articles subequal, each about 1/2 as long as fifth; merus nearly as long as carpus, about twice as long as ischium. Pereopods 3, 4, and 5 with dactyls (Figure 25e-g) relatively short, biunguiculate; flexor terminal process not markedly divergent from curve of article, shorter and slightly broader at base than extensor process. Pereopod 3 (Figure 24i) distinctly overreaching antennal peduncle; propodus more than 5 times as long as dactyl, entire flexor margin armed with movable spinules; carpus about 2/3 as long as propodus, armed with movable spinule at distal end of flexor margin; merus unarmed, about 1 1/2 times as long as propodus. Pereopod 4 (Figure 24j) similar to third but shorter, barely overreaching antennular peduncle. Pereopod 5 (Figure 24k) reaching beyond base of antennular peduncle; propodus with several oblique rows of setae in distal 2/3; carpus unarmed, about 3/4 as long as propodus; merus unarmed, subequal in length to propodus.

Appendix interna on pleopods 2-5 (Figures 23f, 25i) in both sexes. Uropods (Figure 23b) very broad; lateral branch with single fixed tooth on lateral margin just proximal to notch armed with sutural and movable spines marking junction with margin of blade.

Eggs relatively large, more than 1 mm in length.

Variation: As in *Synalpheus agelas*, *S. bousfieldi*, and *S. macclendoni*, a small form of *Synalpheus heardi* occurs in *Agelas dispar* from the Bahama Islands. The Bahamian specimens of *Synalpheus heardi*, like those of *S. bousfieldi* and *S. macclendoni*, differ in several respects from the Gulf of Mexico material. Aside from the overall variability discussed below, the telson is more rectangular, and the carpus of pereopod 2 is composed of four articles, rather than five. The major chela also differs from Gulf material; the dactyl is not strongly hooked, and the distodorsal spine is blunter. Finally, the carpus of the minor pereopod 1 is shorter than in the Gulf material. These differences cast some doubt on the conspecificity of these specimens. They are therefore not considered paratypes, nor are they included in the description. The diagnosis, however, has been expanded to encompass the above differences.

Like most other species of *Synalpheus*, specimens from the Gulf of Mexico vary in both the absolute and relative lengths of the basicerite and scaphocerite. The lateral spine of the basicerite is at least half the length of, and may be subequal to, the scaphocerite. The distal reach of the scaphocerite ranges from the proximal margin to the distal margin of the second antennular segment. An occasional specimen may have more than one tooth on the lateral branch of the uropod proximal to the movable spine. Two otherwise typical ovigerous females have six carpal articles in their second pereopods.

The variation in specimens from the Bahamas is even more marked than that of Gulf specimens, perhaps because they were collected from a greater number of individual sponges. The ocular hoods vary in shape from rounded to rather angular, and the stylocerite may be long, thin, and acute, or short, broad, and blunt. The variation in relative lengths of the basicerite and scaphocerite noted in Gulf specimens is also present in the Bahamian material. Characters most at

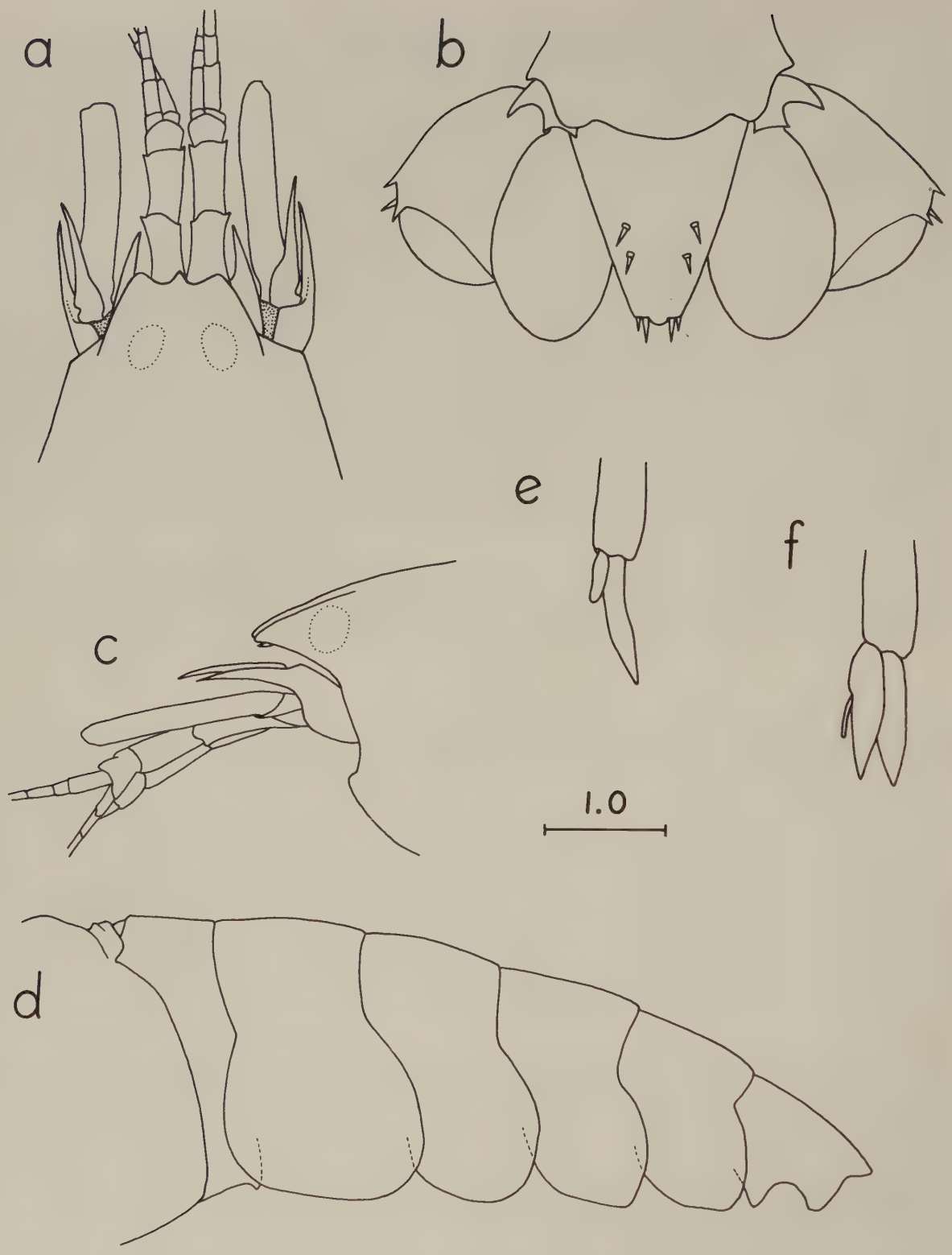

Figure 23. *Synalpheus heardi*, holotype, male, CL 5.5, USNM 189155; a. anterior region, dorsal view; b. telson and uropods; c. anterior region, lateral view; d. abdomen; e. right pleopod 1; f. right pleopod 2.

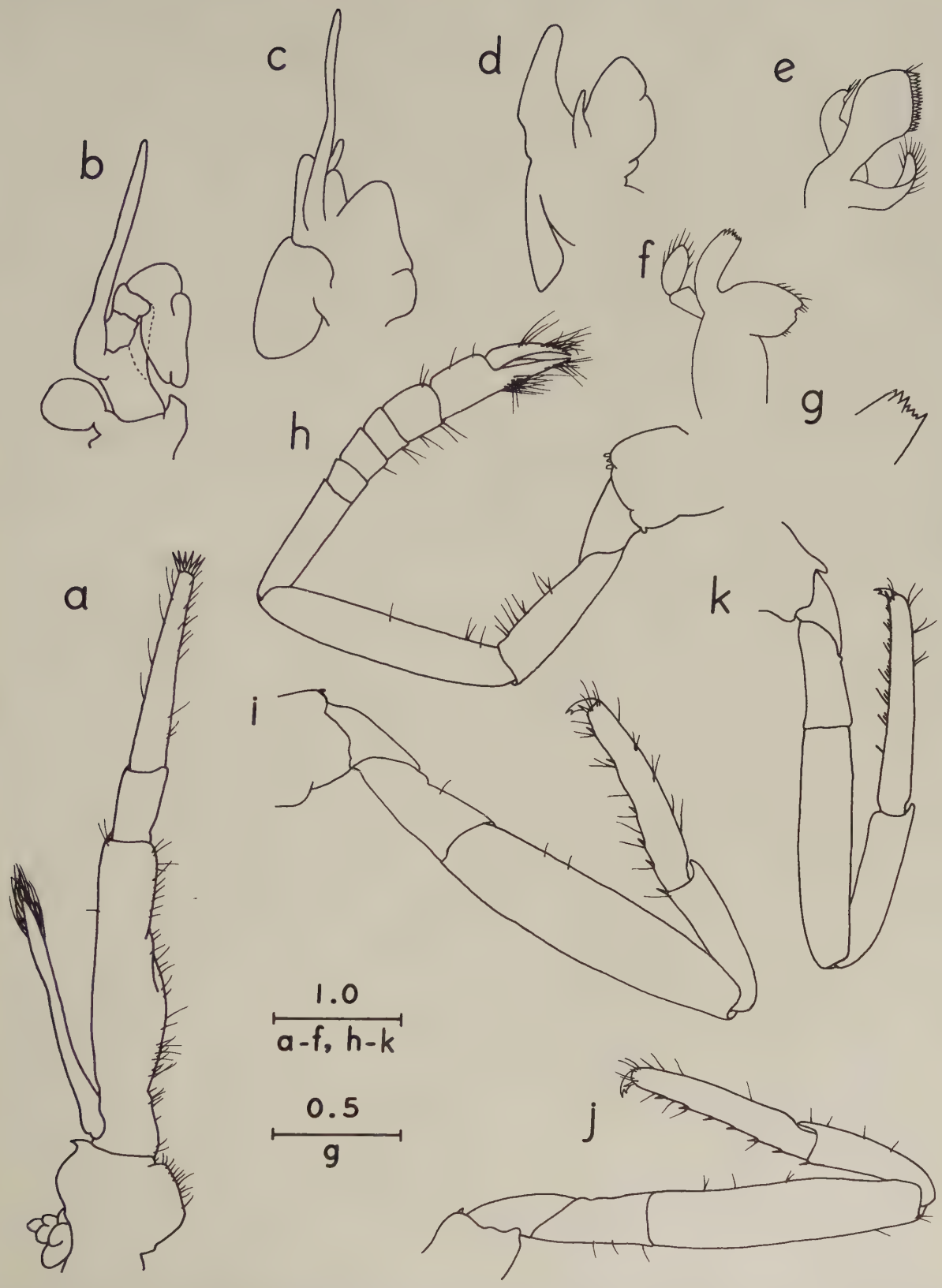

Figure 24. *Synalpheus heardi*, holotype, male, CL 5.5, USNM 189155; a. right maxilliped 3; b. right maxilliped 2; c. right maxilliped 1; d. right maxilla 2; e. right maxilla 1; f. right mandible; g. same, incisor process; h. right pereopod 2; i. right pereopod 3; j. right pereopod 4; k. right pereopod 5.

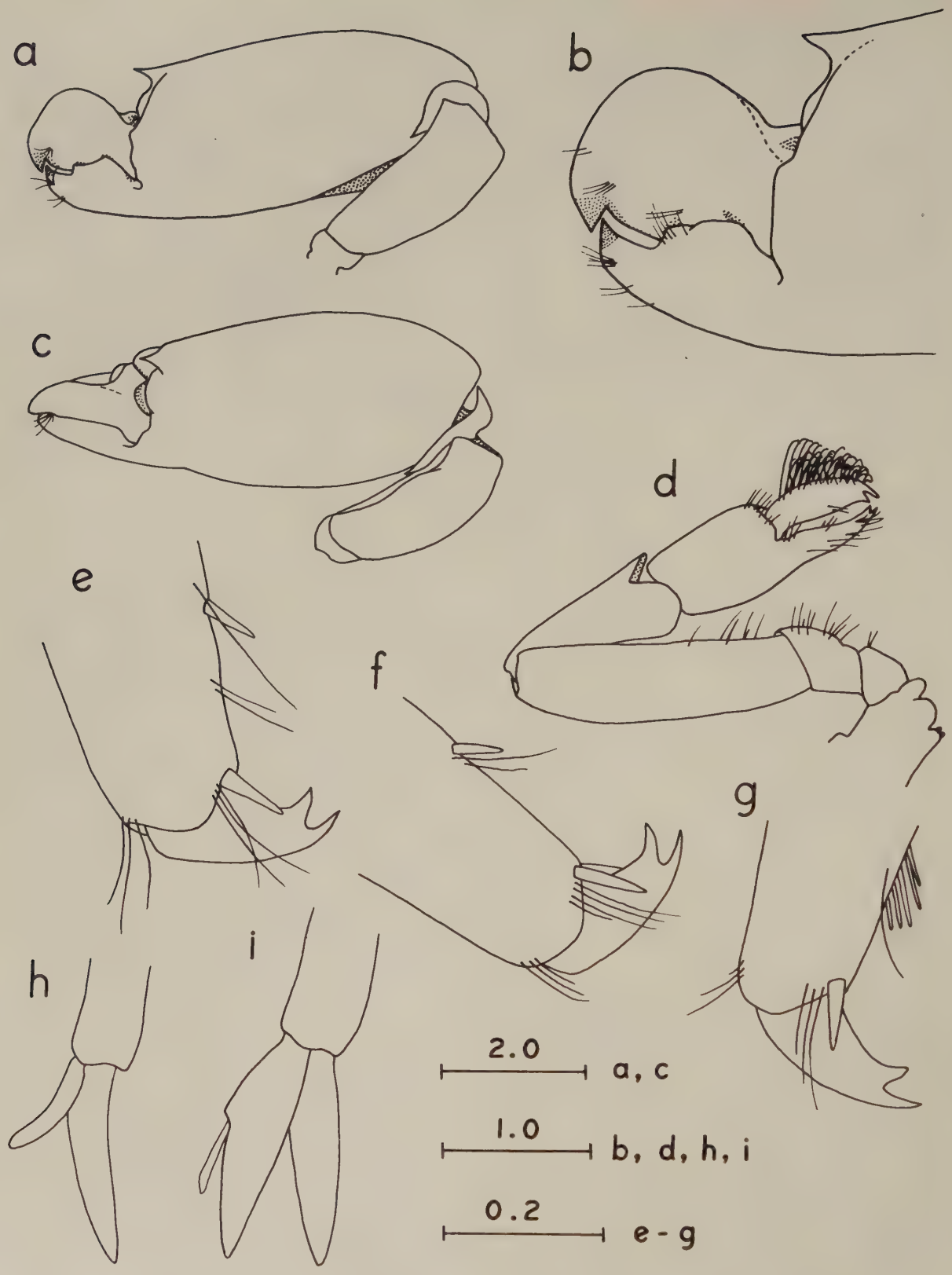

Figure 25. *Synalpheus heardi*, holotype, male, CL 5.5, USNM 189155; a. left major chela, lateral view; b. same, lateral view of distal portion; c. same, dorsal view; d right minor chela; e. dactyl, right pereopod 3; f. dactyl, right pereopod 4; g. dactyl, right pereopod 5. Paratype, ovigerous female, CL 6.6, USNM 189156; h. right pleopod 1; i. right pleopod 2.

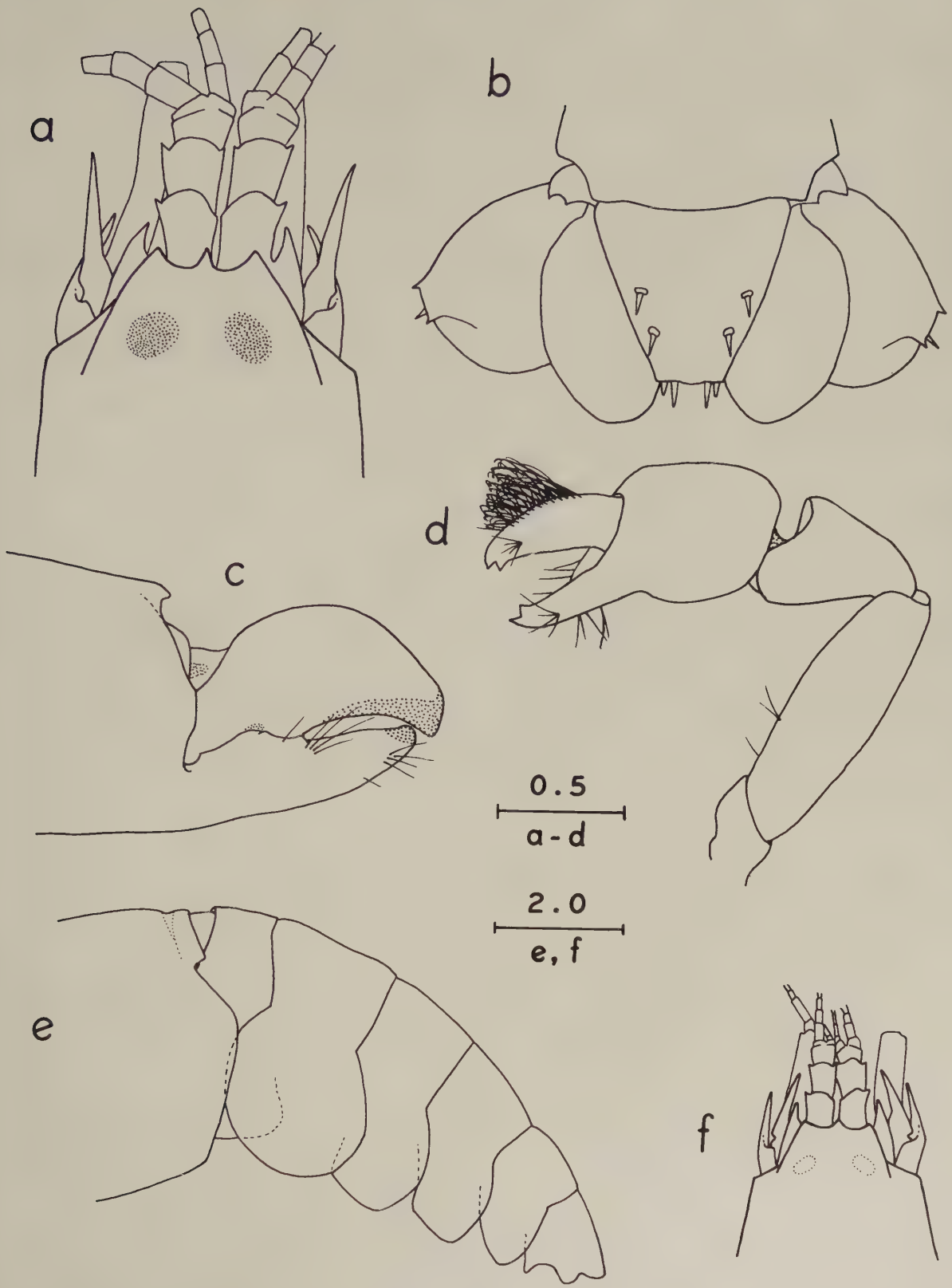

Figure 26. *Synalpheus heardi*, ovigerous female from Bahama Islands, CL 2.8, USNM 189158; a. anterior region, dorsal view. Male from Bahama Islands, CL 2.6, USNM 189159; b. telson and uropods; c. right major chela, lateral view of distal portion; d. left minor chela. Paratype, ovigerous female, CL 6.6, USNM 189156; e. abdomen; f. anterior region, dorsal view.

variance with the Gulf specimens, however, are relatively uniform. The length of the carpus relative to the chela of minor pereopod 1 is consistently about 1/2, the spine of the major chela is always strong but never sharp, and the carpus of pereopod 2 invariably contains four articles.

Size (CL in mm): Gulf of Mexico specimens: males, 5.5-7.9; ovigerous females, 5.4-8.7; juvenile, 4.4. Grand Bahama Island specimens: males, 2.0-2.8; ovigerous females, 2.6-3.3; females with infertile eggs, 2.2-2.4; juveniles, 1.3-1.8.

Habitat: The Florida Middle Ground specimens were within sponges of the genus *Ircinia*. The Bahamian specimens were taken from eleven individuals of *Agelas dispar*.

Type-locality: Eastern Gulf of Mexico, Florida Middle Ground; 28°36'N, 84°16'W; 30-34 m.

Distribution: Eastern Gulf of Mexico, off central western Florida, and from Grand Bahama Island. Known bathymetric distribution ranges from 21 to 73 m.

Etymology: Named for Dr. Richard W. Heard, Jr., who first introduced me to the study of carideans.

Remarks: *Synalpheus heardi* is most closely related to those Gambarelloides species having a single tooth proximal to the distolateral angle of the lateral branch of the uropod, subequally bidentate fingers on the minor chela, and no vestige of an antennal blade. The Gulf species in this complex, *Synalpheus bousfieldi*, *S. herricki*, and *S. brooksi*, are compared to *Synalpheus heardi* in Table 5. The single character which best distinguishes *Synalpheus heardi* from the other three species is the posterior position of the anterior dorsal spines of the telson. Specimens from a single lot of *S. brooksi* (USNM 189152) taken from *Spheciospongia vesparium* collected on the Florida Middle Ground closely approach *Synalpheus heardi* in the dorsal

TABLE 5. COMPARISON OF SIMILAR *Synalpheus* SPECIES HAVING SINGLE TOOTH ON UROPOD PROXIMAL TO THE MOVABLE SPINE.

	S. bousfieldi	*S. brooksi*	*S. herricki*	*S. heardi*
Ocular hoods	blunt, broader than long	angular, longer than broad	angular, longer than broad	blunt, broader than long
Length of stylocerite relative to first antennal segment	1/2, short and broad	1/2, short and broad	3/4, long and slender	3/4, long and slender
Length of basicerite relative to scaphocerite	subequal	subequal	subequal	less than
Carpus/chela ratio of minor chela	1/2	1/2	3/4	3/4
Articles in carpus of pereopod 2	4-5	4-5 (usually 5)	5	4-5
Posterior 1/4 of lateral margins of telson	usually concave	usually straight	usually concave	usually straight
Origin of anterior dorsal spines on telson	anterior 1/3, nearly marginal	anterior 1/2, not marginal	anterior 1/4, not marginal	posterior 1/2, not marginal

spination of the telson (Figure 11e). The short carpus of minor pereopod 1, the angular orbital hoods, and the short stylocerite, as well as the host, however, identify them as *S. brooksi*. All other specimens of *S. brooksi* examined, including the syntypes, have the anterior pair of dorsal spines of the telson clearly arising from the proximal half of the segment.

The Bahamian specimens of *Synalpheus heardi* closely approach *S. brooksi* in some respects; the fingers of the major chela are similar, the stylocerite is short, and the carpus of minor pereopod 1 is about half the length of the fingers and palm. It is possible that these specimens could represent either *S. brooksi* or still another new species, but, in the absence of further material, they are best referred to *Synalpheus heardi* on the basis of their telson spination.

Several specimens intermediate in size between juveniles and mature adults carry infertile eggs. This phenomenon is only exhibited by the Bahamian population.

Synalpheus herricki Coutière, 1909

Figures 27-30

Synalpheus laevimanus var. *longicarpus*: Coutière, 1898, pp. 188-191, [?] figs. 2, 2b [in part]; 1899, pp. 314, 436, 464, 466, figs. 394, 407 [? in part]; 1900, p. 357 [? in part]. [Not *Alpheus laevimanus* Heller, 1862, =*Synalpheus gambarelloides* (Nardo, 1847); not *Alpheus saulcyi* var. *longicarpus* Herrick, 1891].

Synalpheus laevimanus var. *longicarpus* β: Coutière, 1899, pp. 315, 420, 446-449, 466 [? in part]. [Not *Alpheus laevimanus* Heller, 1862, =*Synalpheus gambarelloides* (Nardo, 1847); not *Alpheus saulcyi* var. *longicarpus* Herrick, 1891].

Synalpheus longicarpus β: Coutière, 1899, pp. 454, 468 [? in part]; 1909, p. 3 [in part]. [Not *Alpheus saulcyi* var. *longicarpus* Herrick, 1891].

Synalpheus herricki Coutière, 1909, pp. 74-78, fig. 44; Chace, 1972, p. 93; Ray, 1974, pp. 134-139, figs. 114-121 [in part].

Synalpheus herricki angustipes Coutière, 1909, pp. 76-78, fig. 45.

Synalpheus herricki dimidiatus Coutière, 1909, pp. 76-78, fig. 46.

Synalpheus tanneri Coutière, 1909, pp. 77, 78, fig. 47; Chace, 1972, p. 104.

Not ?*Synalpheus herricki*: Schmitt, 1924b, p. 81 [? =*S. brevifrons* Chace, 1972, *fide* Chace, 1972; ? =*S. bousfieldi* Chace, 1972].

Not *Synalpheus herricki*: Chace, 1937b, pp. 123, 124 [= undescribed species].

[?] *Synalpheus herricki*: Tabb and Manning, 1961, p. 596; Rouse, 1970, pp. 138, 139.

Not *Synalpheus herricki*: Lyons et al., 1971, p. 31; Pequegnat and Ray, 1974, p. 248 [fig. 53b after Coutière, 1909, fig. 44a, illustration of syntype of *S. herricki*]; Ray, 1974, pp. 134-139 [in part]. [= *S. longicarpus* (Herrick, 1891)].

Not *Synalpheus tanneri*: Pequegnat and Ray, 1974, pp. 248, 249 [fig. 53c after Coutière, 1909, fig. 47a, illustration of holotype of *S. tanneri*]; Ray, 1974, pp. 170-175, figs. 162-168. [= *S. bousfieldi* Chace, 1972].

Synalpheus brooksi: Christoffersen, 1979, pp. 335-341, [?] figs. 20-22 [in part]. [Not *Synalpheus brooksi* Coutière, 1909].

Material examined: HOURGLASS STATION C: 1 ♂, 5.6; 19 January 1966; dredge; FSBC I 28425. — 1 ovig. ♀, 5.8; 20 February 1966; dredge; FSBC I 28426. — 1 ovig. ♀, 5.6; 8 September 1966; trawl; FSBC I 28427. — 1 ♂, 5.0; 8 September 1966; dredge; FSBC I 28428. — 1 ♂, 5.4; 1 ovig. ♀, 6.2; 8 October 1966; dredge; FSBC I 28429. — 2 ♂, 5.1, 5.4; 1 December 1966; dredge; FSBC I 28430. — 1 ovig. ♀, 5.5; 6 January 1967; dredge; FSBC I 28431. — 2 ♂, 4.6, 5.1; 1 ovig. ♀, 4.8; 20 January 1967; trawl; FSBC I 28432. — 6 ♂, 4.0-6.0; 4 ovig. ♀, 4.8-7.0; 25 January 1967; trawl; FSBC I 28433. — 1 ♂, 4.1; 3 April 1967; dredge; FSBC I 28434. — 1 juv., 3.0; 31 August

1967; trawl; FSBC I 28435. — 1 ovig. ♀, 7.4; 5 October 1967; dredge; FSBC I 28436. — HOURGLASS STATION D: 1 ♂, 5.4; 20 November 1965; dredge; FSBC I 28437. — 1 juv., 2.8; 9 September 1966; trawl; FSBC I 28438. — 1 juv., 2.3; 1 September 1967; trawl; FSBC I 28439. — HOURGLASS STATION E: 1 juv., 1.6; 26 January 1967; trawl; FSBC I 28440. — 1 juv., 2.3; 6 February 1967; trawl; FSBC I 28441. — 4 juv., 1.8-2.9; 4 April 1967; trawl; FSBC I 28442. — 1 ovig. ♀, 5.6; 14 November 1967; dredge; FSBC I 28443. — HOURGLASS STATION I: 1 ovig. ♀, 5.1; 14 February 1966; dredge; FSBC I 8176. — HOURGLASS STATION K: 1 ♂, 3.9; 1 ovig. ♀, 4.1; 13 January 1966; dredge; FSBC I 28444. — 1 ♂, 4.8; 22 July 1966; trawl; FSBC I 28445. — 1 ovig. ♀, 3.6; 12 November 1966; trawl; FSBC I 28446. — 1 juv., 3.3; 30 January 1967; trawl; FSBC I 28447. — 1 ovig. ♀, 6.8; 15 February 1967; trawl; FSBC I 28448. — HOURGLASS STATION L: 1 ovig. ♀, 5.4; 15 February 1966; trawl; FSBC I 28449. — 2 juv., 2.6, 2.6; 5 September 1966; dredge; FSBC I 28450. — 1 juv., 2.8; 7 December 1966; trawl; FSBC I 28451. — 2 juv., 2.6, 3.2; 13 January 1967; dredge; FSBC I 28452. — 1 juv., 2.7; 16 February 1967; trawl; FSBC I 28453. — 1 juv., 2.3; 9 March 1967; trawl; FSBC I 28454. — 1 juv., 2.5; 16 May 1967; dredge; FSBC I 28455. — HOURGLASS STATION M: 1 ovig. ♀, 4.7; 14 December 1965; trawl; FSBC I 28456. — 2 juv., 2.6, 2.8; 12 April 1966; trawl; FSBC I 28457. — 1 ♂, 4.8; 6 July 1966; dredge; FSBC I 28458. — 2 juv., 1.8, 3.1; 5 September 1966; dredge; USNM 189160. — 1 ♂, 3.5; 1 ovig. ♀, 4.8; 1 ♀, 5.3; 13 January 1967; trawl; FSBC I 28459. — 1 juv., 2.0; 16 February 1967; dredge; FSBC I 28460. — 1 ovig. ♀, 4.6; 8 April 1967; dredge; FSBC I 28461. — 2 juv., 2.2, 3.2; 7 June 1967; dredge; FSBC I 28462. — 2 juv., 2.4, 2.8; 8 August 1967; trawl; FSBC I 28463. — 1 juv., 2.7; 5 September 1967; trawl; FSBC I 28464. — 1 juv., 3.1; 12 October 1967; dredge; FSBC I 28465. — FMG STATION 151: 1 ♂, 4.6; 1 ovig. ♀, 4.9; 26-27 m; 5 October 1978; *Agelas dispar*; MESC 6179-2177. — 1 ovig. ♀, 5.9; 26 m; 18 January 1979; *Madracis decactis*; MESC 6179-2178. — 1 ♀, 4.7; 1 juv., 2.4; 32 m; 28 June 1979; *Agelas dispar*; MESC 6179-2179. — FMG STATION 247: 1 ovig. ♀, 5.3; 29-30 m; 12 October 1978; *Agelas dispar*; MESC 6179-2180. — 7 ♂, 4.2-4.9; 4 ovig. ♀, 4.2-5.3; 11 juv., 2.4-3.7; 27-30 m; 12 October 1978; *Agelas dispar*; MESC 6179-2181. — 2 ♂, 4.0, 4.0; 27-30 m; 12 October 1978; *Agelas dispar*; MESC 6179-2182. — 1 ♂, 4.0; 1 ovig. ♀, 3.9; 30 m; 13 October 1978; *Madracis decactis*; MESC 6179-2183. — 1 ovig. ♀, 5.5; 1 juv., 3.5; 30 m; 24 June 1979; *Agelas dispar*; MESC 6179-2184. — 2 juv., 3.6, damaged; 34 m; 25 June 1979; MESC 6179-2186. — FMG STATION 481: 2 ♂, 4.6, 5.5; 2 ovig. ♀, 5.5, 6.2; 1 juv., 2.9; 27-29 m; 6 October 1978; *Madracis decactis*; MESC 6179-2185. — 1 ovig. ♀, 5.0; 29 m; 8 October 1978; *Agelas dispar*; MESC 6179-2187. — FMG STATION 492: 2 ♂, 4.1, 5.0; 2 ovig. ♀, 4.9, 5.8; 27-34 m; 5 July 1979; *Madracis decactis*; MESC 6179-2188. — OTHER MATERIAL: 1 ovig. ♀, 5.7; Anclote, Florida; LECTOTYPE; USNM 38404. — 78 ♂, 3.8-6.6; 69 ovig. ♀, 4.6-7.9; Anclote, Florida; PARALECTOTYPES; USNM 191020. — 4 ♂, 4.3-6.4; 1 ovig. ♀, 6.4; 1 damaged; Anclote Section, Florida; 23 m; 28 March 1901; *Fish Hawk* Station 7106; SYNTYPES of *S. herricki dimidiatus*; USNM 38405. — 1 ♀, 5.8; off Cape San Blas, Florida; 29°15'30"N, 85°29'30"W; 49 m; 17 February 1885; *Albatross* Station 2372; HOLOTYPE of *S. tanneri*; USNM 38407.

Diagnosis: Rostrum (Figures 27d, 30b) narrower and usually longer than triangular ocular hoods, very weakly convex ventrally. Pleuron on first abdominal somite of male (Figure 30c) bearing hooked tooth posteriorly, that of second rounded anteriorly but with obscure, blunt projection posteriorly, those of third, fourth, and fifth with progressively shallower sinuses ventrally between anterior and posterior margins, that of sixth bluntly acute. Telson (Figures 27f, 30a, d) elongate, considerably narrower posteriorly than anteriorly, lateral margins concave in posterior 1/2; dorsal surface with 2 pairs of strong spines, posterior pair arising just anterior to midlength of segment, anterior pair situated about midway between posterior pair and anterior margin. Stylocerite (Figures 27d, 30b) long and slender, usually reaching at least to distal 1/4 of first segment of antennular peduncle. Scaphocerite usually subequal to lateral spine of basicerite, blade absent; basicerite not armed dorsally. Palm of major chela (Figures 27g, 28a) terminating distodorsally in

stout, acute spine. Fingers of minor chela (Figures 28b, 30g) deeply bidentate, tips arranged in plane of fingers, dactyl with dense fringe of curved hairs on extensor surface; length of carpus at least 3/4 that of chela. Carpus of pereopod 2 (Figure 28c) composed of 5 articles. Dactyls of posterior 3 pereopods (Figure 28e, g, i) with terminal teeth subparallel, proximal tooth slightly stronger than distal tooth. Lateral branch of uropod (Figures 27f, 30a, d) usually with single tooth proximal to movable spine.

Redescription: Rostrum (Figures 27d, 30b) narrower than ocular hoods, very weakly convex ventrally, without true ventral process. Triangular ocular hoods widely separated from rostrum by deep, rounded sinuses. Pterygostomial angle of carapace produced as acuminate lobe.

Pleura of anterior 5 abdominal somites broadly rounded in female (Figure 27a), that of sixth acuminate. Pleuron of first somite of male (Figure 30c) bearing strong, hooked tooth posteriorly, that of second rounded anteriorly but with obscure, blunt projection posteriorly, those of third, fourth, and fifth with progressively shallower sinuses ventrally between anterior and posterior margins, that of sixth bluntly acute. Telson (Figures 27f, 30d) elongate, considerably broader anteriorly than posteriorly, concave in posterior half; dorsal surface armed with 2 pairs of strong spines, anterior pair situated midway between posterior pair and anterior margin; posterior margin armed with 2 pairs of unequal spines.

Stylocerite (Figures 27d, 30b) long, slender, extending about to distal 1/4 of first segment of antennular peduncle. Segments of antennular peduncle elongate; first longer than second, second longer than third.

Scaphocerite reaching at least to distal 1/3 of segment 2 of antennular peduncle; blade absent. Basicerite neither armed nor angulate dorsally; lateral spine long, stout, reaching about as far as tip of scaphocerite. Carpocerite of female about 4 1/2 times as long as broad, that of male about 5 times as long as broad, each slightly overreaching antennular peduncles.

Mouthparts as figured (Figure 29a-f). Mandible with 7 marginal teeth on incisor process. Palp of maxilliped 1 consisting of 2 segments. Maxilliped 3 reaching slightly beyond antennal peduncle; exopod falling slightly short of distal margin of antepenultimate segment.

Major pereopod 1 (Figure 28a) overreaching antennal peduncle by nearly entire length of chela; chela 2 1/2 times as long as broad, not noticeably twisted; fingers (Figure 27g) about 1/3 as long as palm, dactyl hooked; palm terminating distodorsally in stout, acute spine; carpus very short and broad; merus unarmed, half as long as palm. Chela of minor pereopod 1 (Figures 28b, 30g) not quite 3 times as long as broad; fingers deeply bidentate; dactyl with dense fringe of curved hairs on extensor surface; length of carpus about 3/4 that of chela. Pereopod 2 (Figure 28c) overreaching antennal peduncle by length of chela and first article of carpus; fingers equal to length of palm; carpus twice as long as chela, composed of 5 articles; proximal article subequal to combined lengths of distal 4; second, third, and fourth articles subequal, each about 1/2 as long as fifth; merus nearly as long as carpus and about 1 3/4 times as long as ischium. Third, fourth, and fifth pereopods with dactyls (Figure 28e, g, i) relatively short, biunguiculate; flexor terminal process not markedly divergent from curve of article, shorter and slightly broader at base than extensor process. Pereopod 3 (Figure 28d) barely overreaching antennal peduncle; propodus more than 5 times as long as dactyl, entire flexor margin armed with movable spinules; carpus about 2/3 as long as propodus, armed with movable spinule at distal end of flexor margin; merus unarmed, about 1 1/2 times as long as propodus. Pereopod 4 (Figure 28f) similar to third but

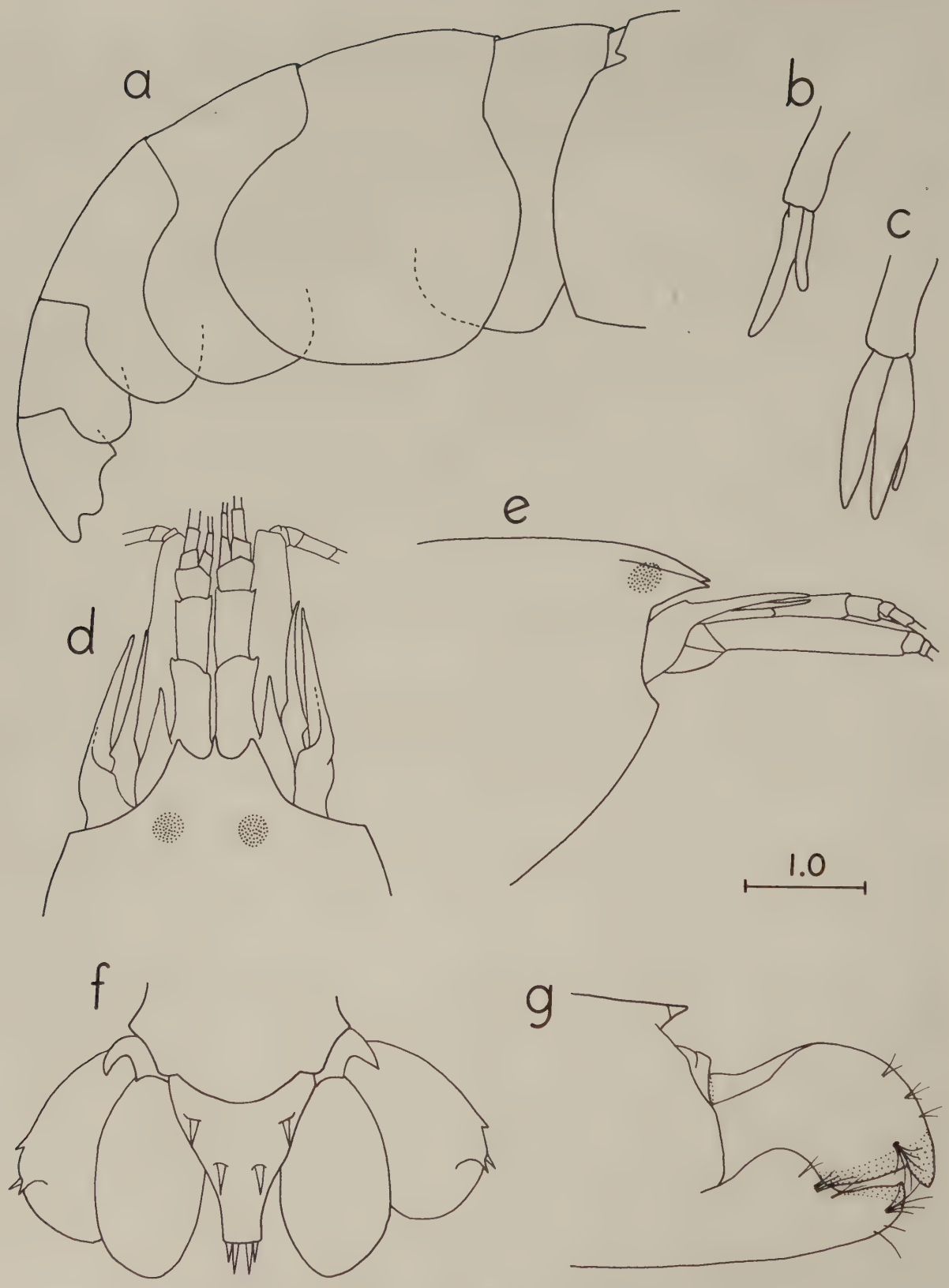

Figure 27. *Synalpheus herricki*, lectotype, ovigerous female, CL 5.7, USNM 38404; a. abdomen; b. left pleopod 1; c. left pleopod 2; d. anterior region, dorsal view; e. same, lateral view; f. telson and uropods; g. right major chela, lateral view of distal portion.

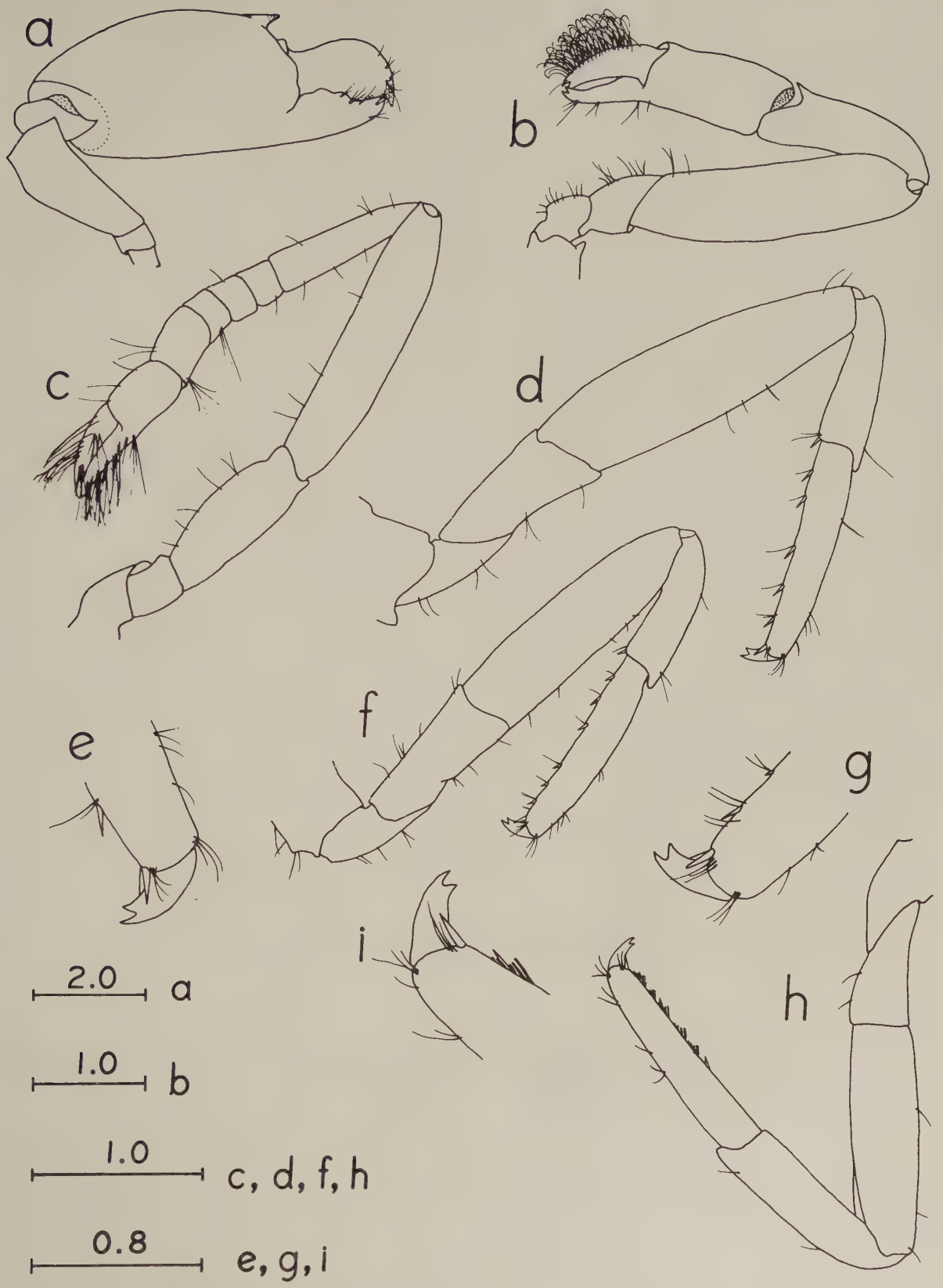

Figure 28. *Synalpheus herricki*, lectotype, ovigerous female, CL 5.7, USNM 38404; a. right major chela, lateral view; b. left minor chela; c. left pereopod 2; d. left pereopod 3; e. same, dactyl; f. left pereopod 4; g. same, dactyl; h. left pereopod 5; i. same, dactyl.

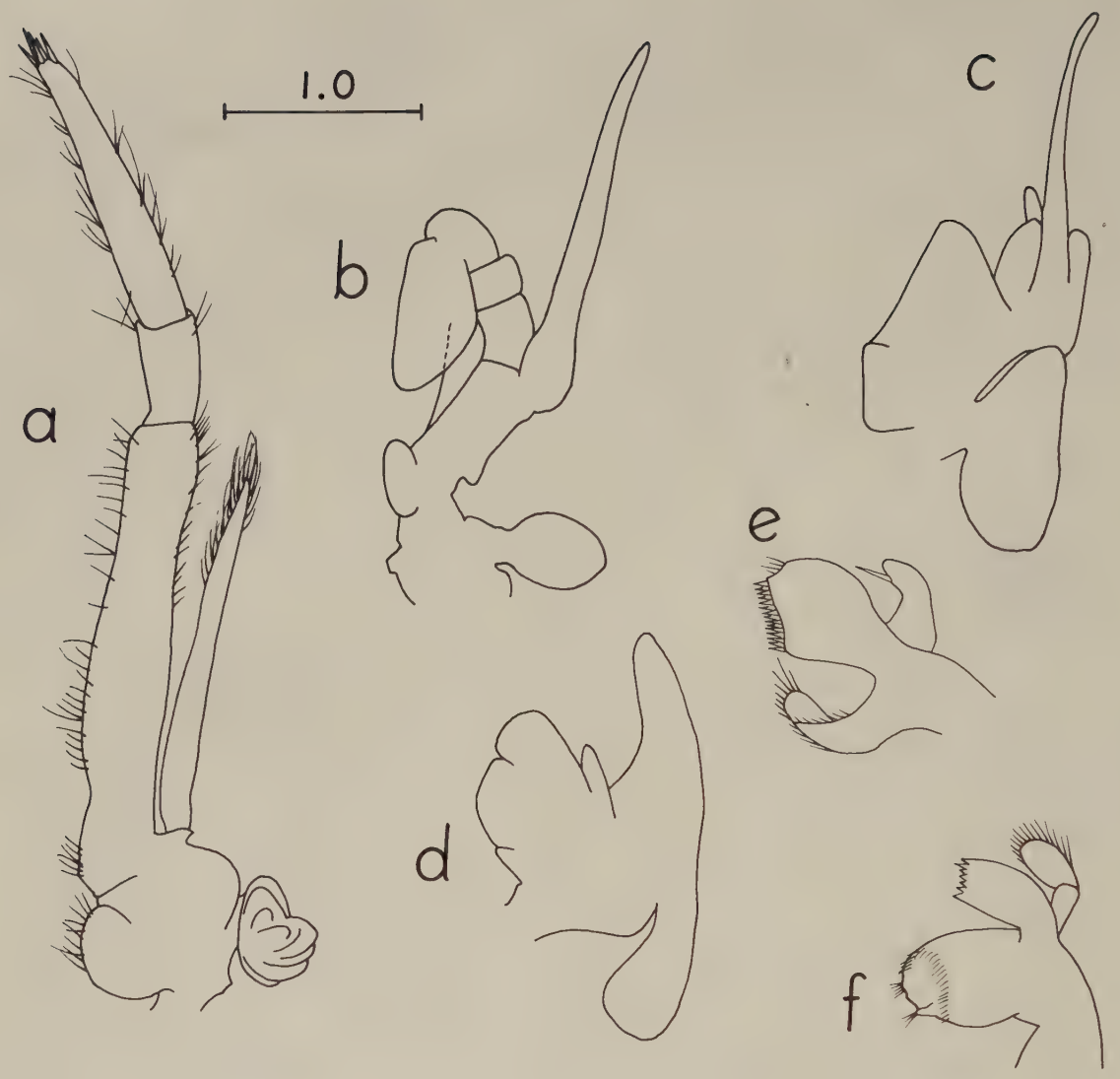

Figure 29. *Synalpheus herricki*, lectotype, ovigerous female, CL 5.7, USNM 38404; a. left maxilliped 3; b. left maxilliped 2; c. left maxilliped 1; d. left maxilla 2; e. left maxilla 1; f. left mandible.

shorter, not overreaching antennular peduncle. Pereopod 5 (Figure 28h) reaching about as far as base of antennular peduncle; propodus with several oblique rows of setae in distal 2/3; carpus unarmed, about 4/5 length of propodus; merus unarmed, subequal in length to propodus.

Appendix interna on pleopods 2-5 in both sexes (Figures 27c, 30f). Uropods (Figures 27f, 30d) very broad; lateral branch with single (rarely 2 or more) fixed tooth (teeth) on lateral margin proximal to notch armed with sutural and movable spines marking junction with margin of blade.

Eggs relatively large, 1 mm or more in length.

Variation: In his key to the western Atlantic species of *Synalpheus*, Chace (1972) placed this species among those with two or more fixed teeth on the lateral margin of the uropod proximal to the distolateral angle. Lacking any material in the Smithsonian-Bredin collections, he doubtlessly

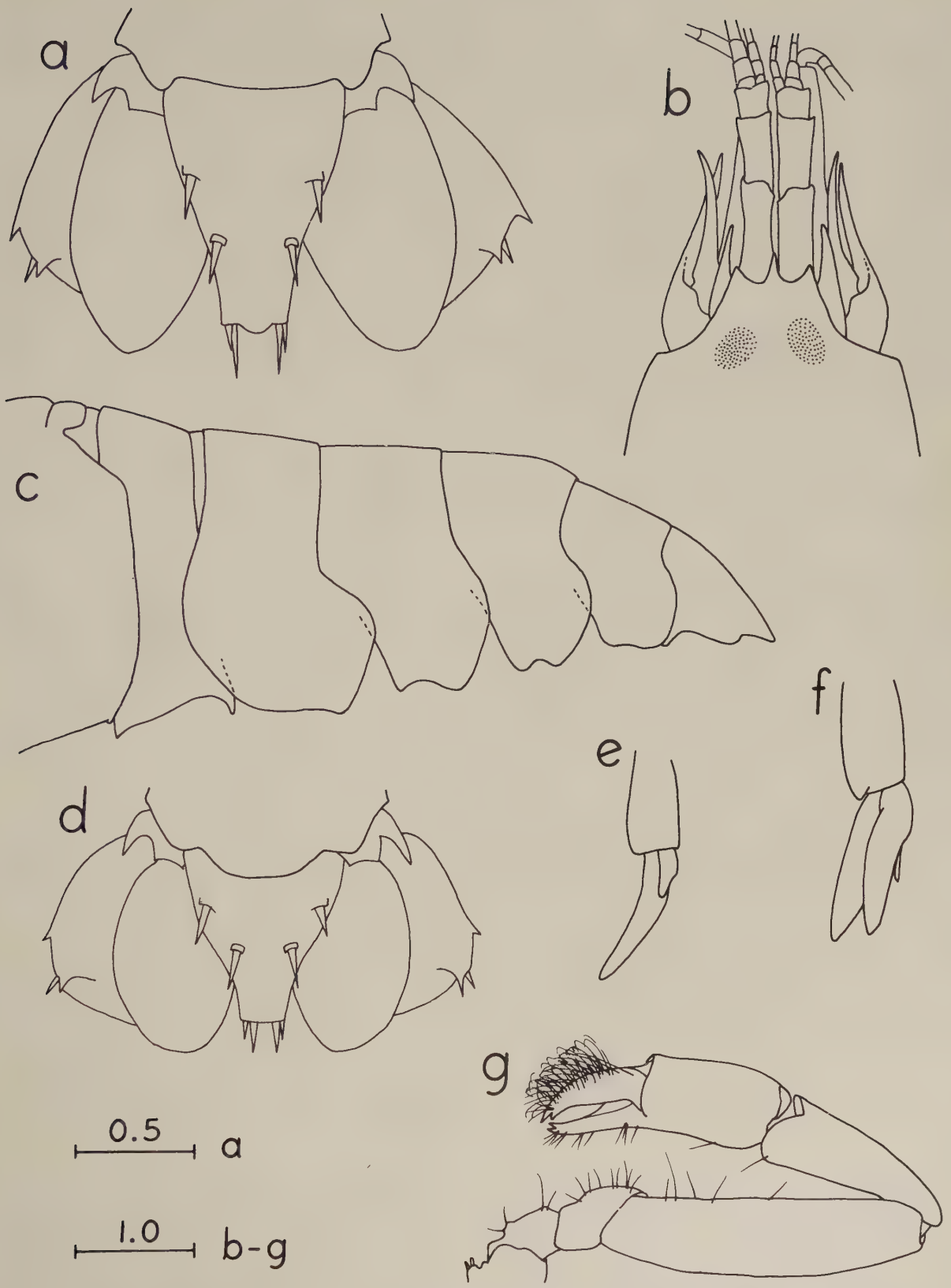

Figure 30. *Synalpheus herricki*, juvenile, CL 3.1, USNM 189160; a. telson and uropods. Paralectotype, male, CL 6.0, USNM 38404; b. anterior region, dorsal view; c. abdomen; d. telson and uropods; e. left pleopod 1; f. left pleopod 2; g. left minor chela.

relied on Coutière's (1909) description (four teeth in females, three or two in males) and figure (44u) for this information. Examination of Coutière's type-series, however, reveals significant variation. Of 70 females, 24 have 2 teeth proximal to the movable spine on either the right or left uropod, the other having only 1; 7 have 2 teeth on each uropod, and 2 specimens have 3 teeth on one uropod and 2 on the other; the majority (37) have only a single tooth on each uropod proximal to the movable spine. The armature of the uropods of the male types is similar; 1 specimen has a single tooth on one side and lacks any teeth on the other; 18 have 2 teeth on one side and 1 on the other; 1 has 3 teeth on one side and 1 on the other; 8 have 2 teeth on each uropod; 2 have 3 teeth on each uropod; 1 has 4 teeth on each uropod, and 1 specimen has 2 teeth on one side and 4 on the other; the remainder (46) have only a single tooth on each uropod proximal to the movable spine. Variation of this type is all too common among species of *Synalpheus*, even when the specimens, as these were, are from a single sample. Only three of the other specimens of *S. herricki* examined had more than a single fixed tooth proximal to the movable spine on the uropods, indicating the usual condition of the species.

Juveniles of *S. herricki* have a rounded medial projection on the distal margin of the telson between the distal spines (Figure 30a). Although the projection is retained in some adults, in most it is obscured, and the distal margin is V-shaped or straight.

Color: Based on notes taken from live material from the Florida Middle Ground: Carapace and abdomen transparent pale tan, rostrum and ocular hoods clear; gastric region golden yellow internally; ovaries gray green; eggs with green yolk. Antennae and antennules clear. Maxilliped 3 pale tan with scattered dark chromatophores on antepenultimate segment. Major and minor pereopods 1 very pale tan, faintly darker orange tan on margins of fingers. Remaining pereopods, pleopods, telson, and uropods clear.

Size (CL in mm): Males, 3.5-6.6; ovigerous females, 4.6-7.4; juveniles, 1.6-3.3.

Habitat: Associated with the sponge, *Agelas dispar*, and the coral, *Madracis decactis*, on the Florida Middle Ground. Hourglass specimens were collected from bottom temperatures of 15.5 to 25.5°C and from bottom salinities of 31.6 to 36.6°/∞. Ranges of the same parameters for Florida Middle Ground specimens were 17.1 to 26.0°C and 34.6 to 36.2°/∞.

Distribution: Atlantic: questionably from Eleuthera, Bahama Islands (Chace, 1972); Gulf of Mexico: questionably from Florida Bay (Tabb and Manning, 1961); off central western Florida from Sanibel Island to Cape San Blas (Coutière, 1909; present study). Distributed bathymetrically from 6 to 73 m (present study).

Remarks: *Synalpheus herricki* is one of three species confused by Coutière (1898; 1899) under the names *S. laevimanus longicarpus* and *S. longicarpus* β (see Coutière, 1909).

Previous records of *S. herricki* are often unreliable because of the confusion concerning the number of teeth on the lateral branch of the uropod. Because their specimen was in a sponge with *S. pectiniger*, the report by Tabb and Manning (1961) from Florida Bay is questionable. *Synalpheus longicarpus*, a species with a long carpus in the minor pereopod 1 and numerous teeth on the uropod, is a common associate of *S. pectiniger* in south Florida and may have been confused with *S. herricki*.

The Barbados specimen that Schmitt (1924b) questionably assigned to *S. herricki* has

already been mentioned by Chace (1972) as bearing some resemblance to *S. brevifrons*. As Chace (1972) pointed out, the specimen is not identifiable, having dried out at some time, but the telson seems to more closely resemble that of *S. bousfieldi*.

Chace (1937b) reported *S. herricki* from Lower California. I have examined two of these specimens (MCZ 9500). Although they closely resemble *S. herricki*, the third maxilliped is tipped distally with a dense brush of setae rather than the circlet of spines typical of all American *Synalpheus* except *S. barahonensis*. These specimens, which differ from *S. barahonensis* by having five carpal articles on pereopod 2, represent an undescribed species.

Rouse (1970) noted that his specimens from southwest Florida were taken from loggerhead sponges. In south Florida, *S. longicarpus* and *S. brooksi* are typically associated with loggerhead sponges. Rouse (1970) remarked on the difficulties of identifying Gambarelloides *Synalpheus* species, and his specimen may have represented one or both of the above species.

Lyons et al. (1971), Pequegnat and Ray (1974), and Ray (1974) have reported the occurrence of *S. herricki* from the Gulf of Mexico. I have examined these specimens, and they seem to be typical *S. longicarpus*.

Synalpheus herricki angustipes and *S. herricki dimidiatus* are among the most questionable of Coutière's many subspecies. Both were from the same sample as specimens of the typical form, and each falls easily within the range of variation of *S. herricki*.

Inasmuch as the only substantive distinction between *S. herricki* and *S. tanneri* is the number of uropodal teeth proximal to the movable spine, the latter is placed in the synonymy of the former. The specimens reported as *S. tanneri* by Pequegnat and Ray (1974) and Ray (1974) are actually *S. bousfieldi*, rather than *S. herricki*.

Synalpheus herricki was incorrectly regarded as a junior synonym of *S. brooksi* by Christoffersen (1979), who accepted a rather wide range of variation in relatively few specimens. Without examining his South American material, it is impossible to determine if the range of *S. herricki* extends to Brazil. To date, all specimens I have examined which actually proved to be *S. herricki* were collected from off western Florida.

Synalpheus herricki exhibited an extended breeding season in the Hourglass study area. Ovigerous females were collected during all months except March and May through August. Juveniles were present every month but July and November. Considering the intermittent nature of successful collections (Table 6), it seems likely that breeding occurs year-round.

With a single exception, *Synalpheus herricki* were collected only at the three outermost stations of each transect. Population abundance was greatest at the 73 m stations, followed by the 37 and 55 m stations, respectively (Figure 31). A distinct trend in the distribution of juveniles is also evident in Figure 31. The abundance of juveniles becomes progressively greater with increasing depth. Proportions of juveniles among the population at each depth range from a low of 8.3% at the 37 m stations to a high of 90.0% at the 55 m stations. At the 73 m stations, 60.9% of the population of *S. herricki* are juvenile. Larval recruitment, but not necessarily survival, is evidently greater at the deeper stations.

TABLE 6. MONTHLY CATCH OF *Synalpheus herricki* AT HOURGLASS STATIONS.

Synalpheus herricki																													
STA	1965					1966													1967										TOT
	A	S	O	N	D	J	F	M	A	M	J	J	J sp	A	S	O	N	D	J	J sp	F	M	A	M	J	J	A	S	O	N	
A																															
B_1																															
B_2																															
C_1																2		2	1	10			1					1	1		18
C_2						1	1								2				3									1			7
D_1																												1			1
D_2				1											1																2
E																				1	1		4							1	7
I							1																								1
J																															
K						2							1				1			1	1										6
L							1								2			1	2		1	1		1							9
M					1				2			1			2				3		1		1		2		2	1	1		17
TOT				1	1	3	3		2			1	1		7	2	1	3	9	12	4	1	6	1	2		2	3	2	1	68

Subscripts 1, 2, and SP represent regular (night), post (day), and supplementary (45 ft trawl) cruises.

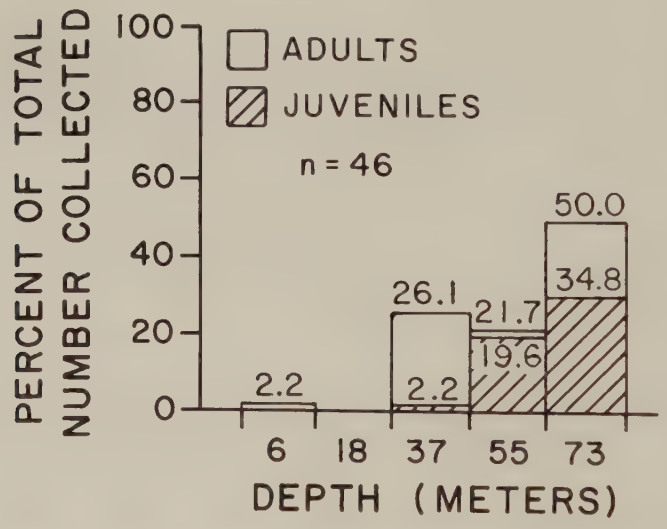

Figure 31. Relative abundance of adult and juvenile *Synalpheus herricki* by depth during regular (night) sampling at Hourglass stations. Dredge and trawl samples combined; 45-ft trawl catches omitted.

Synalpheus longicarpus (Herrick, 1891)

Figures 32-35

Alpheus saulcyi var. *longicarpus* Herrick, 1891, pp. 381-384, pl. 21, figs. 5-7, pl. 22, figs. 3, 11, [?]14, 17, pl. 24, [?]figs. 2, 4-9 [in part]; Coutière, 1899, pp. 39, 48, 418-422, 444, 482 [in part]; Arndt, 1933, p. 249 [in part]. [Not *Alpheus saulcyi* Guérin-Méneville, 1856].

Synalpheus laevimanus var. *longicarpus*: Coutière, 1898, pp. 188-191, figs. [?]2, [?]2′, 2‴, 2a, [?]2b, 2b′, [?]2b″ [in part]; 1899, pp. 48, 129, 130, 136, 156, 200, 207, 294, 448, 456, 464, 466, 482, figs. 116, 123, 153, 241, 360, 361 [? in part]; 1900, p. 357 [? in part]; Arndt, 1933, p. 249 [? in part]. [Not *Alpheus laevimanus* Heller, 1862, =*Synalpheus gambarelloides* (Nardo, 1847)].

Synalpheus laevimanus var. *longicarpus* α: Coutière, 1899, pp. 447, 449; 1909, p. 3. [Not *Alpheus laevimanus* Heller, 1862, =*Synalpheus gambarelloides* (Nardo, 1847)].

Not *Synalpheus laevimanus* var. *longicarpus*: Verrill, 1900, p. 579; Rathbun, 1901, p. 110. [=*Synalpheus goodei* Coutière, 1909].

Synalpheus longicarpus: Coutière, 1907, pp. 610, 611; 1909, pp. 53-57, fig. 31; Zimmer, 1913, pp. 384, 385, fig. B; Hay and Shore, 1918, p. 383, fig. 6 [after Coutière, 1909], pl. 26, fig. 2; Verrill, 1922, pp. 113-116, pl. 25 [fig. 1a-h after Coutière, 1909], pl. 34, [?] figs. 3, 3c, 5, 5a [after Herrick, 1891], pl. 36, [?]figs. 4, 5, 5a [after Herrick, 1891]; Schmitt, 1924a, p. 80; Arndt, 1933, p. 249; Schmitt, 1936, p. 369; Pearse, 1950, p. 150; Pearse and Williams, 1951, p. 143; Wass, 1955, p. 144; Williams, 1965, pp. 73, 74, fig. 59 [after Coutière, 1909]; Cerame-Vivas and Gray, 1966, p. 263; Dobkin, 1969, p. 941; Abele, 1970, pp. 31, 32; Lyons et al., 1971, p. 31; Menzel, 1971, p. 78; Chace, 1972, pp. 93, 94; Soto, 1972, p. 19; Ray, 1974, pp. 140-148, figs. 122-132 [? in part]; Young, 1978, p. 174; Christoffersen, 1979, pp. 344-350, [?]figs. 23-27 [? in part]; Rodriguez, 1980, pp. 160, 161.

Synalpheus longicarpus approxima Coutière, 1909, pp. 56, 57, fig. 32.

[?]*Synalpheus longicarpus*: Boone, 1930, pp. 178, 179, pl. 65.

Synalpheus mcclendoni: Pearse, 1932b, pp. 119, 120; Arndt, 1933, pp. 248, 249; Westinga and Hoetjes, 1981, p. 148. [Not *Synalpheus macclendoni* Coutière, 1910].

Synalpheus longicarpus var. ?: Chace, 1956a, pp. 148, 149.

Synalpheus herricki: Lyons et al., 1971, p. 31; Pequegnat and Ray, 1974, p. 248 [not fig. 53b, = Coutière, 1909, fig. 44a, illustration of syntype of *S. herricki*]; Ray, 1974, pp. 134-139 [in part]. [Not *Synalpheus herricki* Coutière, 1909].

Not *Synalpheus longicarpus*: Corrêa, 1972, p. 3. [? =*Synalpheus brooksi* Coutière, 1909].

? *Synalpheus longicarpus*: Markham and McDermott, 1981, p. 1270.

Material examined: HOURGLASS STATION B: 1 ♂, 7.0; 7 February 1966; trawl; FSBC I 28466. — 1 juv., 4.6; 19 November 1966; trawl; FSBC I 28467. — HOURGLASS STATION C: 2 ovig. ♀, 7.2, 7.4; 1 damaged; 31 August 1965; dredge; FSBC I 28468. — 1 ovig. ♀, 6.5; 5 October 1965; dredge; FSBC I 28469. — 1 ♂, 6.1; 1 ovig. ♀, 8.1; 8 November 1965; dredge; FSBC I 28470. — 2 ♂, 5.4, 5.4; 3 January 1966; dredge; FSBC I 28471. — 1 ♂, 6.5; 1 ovig. ♀, 6.8; 3 March 1966; trawl; FSBC I 28472. — 2 ovig. ♀, 5.8, 7.7; 27 March 1966; dredge; FSBC I 28473. — 1 ovig. ♀, 7.4; 6 April 1966; dredge; FSBC I 28474. — 1 ♂, 6.3; 1 ovig. ♀, 7.7; 16 April 1966; dredge; FSBC I 28475. — 1 ♂, 6.7; 1 ovig. ♀, 7.9; 2 May 1966; trawl; FSBC I 28476. — 2 ♂, 6.7, 7.6; 3 ovig. ♀, 7.4-8.6; 19 May 1966; trawl; FSBC I 28477. — 1 ♀ (with hemiarthrine), 7.0; 18 June 1966; trawl; FSBC I 23882. — 2 ♂, 5.5, 6.1; 3 ovig. ♀, 5.9-7.2; 4 juv., 4.1-5.0; 18 June 1966; trawl; FSBC I 28478. — 1 ovig. ♀, 7.2; 2 July 1966; trawl; FSBC I 28479. — 1 ♂, 7.0; 2 ovig. ♀, 5.9, 7.4; 2 July 1966; dredge; FSBC I 28480. — 1 ♂, 6.7; 1 ovig. ♀, 7.2; 11 August 1966; trawl; FSBC I 28481. — 1 ♂ (with bopyrid), 5.1; 8 September 1966; trawl; FSBC I 23859. — 5 ♀ (with bopyrids), 5.5-7.7; 8 September 1966; trawl; FSBC I 23883. — 26 ♂, 5.6-8.1; 24 ovig. ♀ (1 with hemiarthrine, 7.4), 5.2-8.1; 3 juv., 3.4-4.7; 8 September 1966; trawl; FSBC I 28482. — 1 ♂, 5.2; 1 damaged adult; 1 juv., 4.6; 8 October 1966; dredge; FSBC I 28483. — 1 ♂, 5.9; 6 November 1966; trawl; FSBC I 28484. — 3 ♂, 6.5-8.1; 19 November 1966; trawl; FSBC I 28485. — 1 ♂, 7.0; 13 December 1966; trawl; FSBC I 28486. — 1 ♂ (with bopyrid), 6.3; 1 ovig. ♀ (with hemiarthrine), 6.8; 25 January 1967; trawl; FSBC I 23889. — 9 ♂, 5.9-7.0; 5 ovig. ♀, 7.3-8.3; 5 juv., 2.3-4.9; 1 damaged; 25 January 1967; trawl; FSBC I 28487. — 1 ovig. ♀, 5.7; 5 February 1967; trawl; FSBC I 28488. — 1 ♂, 7.2; 5 February 1967; dredge; FSBC I 28489. — 1 ovig. ♀, 5.6; 3 April 1967; dredge; FSBC I 28490. — 2 ♂, 6.7, 7.8; 12 April 1967; trawl; FSBC I 28491. — 1 ovig. ♀, 6.1; 20 May 1967; dredge; FSBC I 28492. — 1 ovig. ♀, 6.1; 1 juv., 4.3; 21 June 1967; trawl; FSBC I 28493. — 1 ovig. ♀, 7.6; 11 August 1967; trawl; FSBC I 28494. — 1 ♂, 6.7; 31 August 1967; trawl; FSBC I 28495. — 1 ♂, 6.1; 1 ovig. ♀, 7.9; 5 October 1967; trawl; FSBC I 28496. — 1 ♂, 6.8; 1 ovig. ♀, 7.3; 1 ♀, 4.5; 25 October 1967; trawl; FSBC I 28497. — HOURGLASS STATION D: 1 juv., 2.7; 11 July 1966; trawl; FSBC I 28498. — 1 ♂ (with bopyrid), 6.4; 26 January 1967; trawl; FSBC I 23865. — 1 ovig. ♀ (with hemiarthrine), 7.7; 26 January 1967; trawl; FSBC I 23890. — 1 ovig. ♀, 7.4; 6 February 1967; trawl; FSBC I 28499. — HOURGLASS STATION E: 1 ♂, 6.0; 26 January 1967; trawl; FSBC I 28500. —

HOURGLASS STATION J: 5 ♂, 6.5-7.6; 5 ovig. ♀, 7.0-9.1; 8 juv., 1.9-4.3; 5 August 1966; dredge; FSBC I 28501. — 8 ♂, 5.8-7.7; 6 ovig. ♀, 6.6-8.7; 1 ♀ (with hemiarthrine), 6.1; 6 juv., 3.6-5.0; 12 October 1966; trawl; USNM 189162. — 2 ♂, 6.1, 6.7; 1 damaged adult, 5.5; 6 juv., 1.8-4.3; 5 July 1967; dredge; FSBC I 28502. — HOURGLASS STATION K: 1 ♂ (with hemiarthrine), 7.1; 13 January 1966; trawl; FSBC I 23880. — 1 ♂, 6.4; 1 ovig. ♀, 7.9; 13 January 1966; trawl; FSBC I 28503. — 3 ♂, 6.1-7.2; 13 January 1966; dredge; FSBC I 28504. — 1 ♂, 6.7; 1 ovig. ♀, 8.6; 21 March 1966; trawl; FSBC I 28505. — 1 ♂, 5.0; 1 ovig. ♀, 7.2; 5 July 1966; trawl; FSBC I 28506. — 1 ♀ (with hemiarthrine), 7.5; 22 July 1966; trawl; FSBC I 23884. — 1 ♀ (with hemiarthrine), 7.4; 22 July 1966; trawl; FSBC I 23891. — 11 ♂, 5.6-8.1; 6 ovig. ♀, 6.8-8.7; 1 juv., 4.6; 22 July 1966; trawl; FSBC I 28507. — 1 ovig. ♀, 7.2; 4 September 1966; trawl; FSBC I 28508. — 2 ♂ (1 damaged), 6.2; 1 ovig. ♀, damaged; 12 November 1966; trawl; FSBC I 28509. — 2 ♂, 5.9, 6.5; 1 ovig. ♀, 6.6; 12 January 1967; trawl; FSBC I 28510. — 2 ovig. ♀, 6.0, 7.2; 30 January 1967; trawl; FSBC I 28511. — 10 ♂, 6.3-7.3; 5 ovig. ♀, 5.3-9.3; 1 juv., 4.3; 7 April 1967; trawl; FSBC I 28512. — 2 ♂, 6.7, 6.8; 1 ovig. ♀, 7.0; 1 damaged adult, 7.7; 1 juv., 3.5; 7 April 1967; dredge; FSBC I 28513. — 1 ♂, 7.4; 4 September 1967; dredge; FSBC I 28514. — 2 ovig. ♀, 6.5, 8.5; 1 damaged; 14 November 1967; dredge; FSBC I 28515. — HOURGLASS STATION L: 1 ovig. ♀, 8.6; 22 January 1966; trawl; FSBC I 28516. — 1 juv., 2.9; 13 January 1967; trawl; FSBC I 28517. — FMG STATION 151: 1 juv., 4.0; 28 m; 5 October 1978; *Agelas dispar*; MESC 6179-2189. — FMG STATION 247: 2 juv., 3.4, 4.9; 27-30 m; 12 October 1978; *Agelas dispar*; MESC 6179-2190. —12 ♂ (1 with bopyrid), 5.4-6.5; 9 ovig. ♀ (1 with bopyrid), 5.6-8.8; 2 juv., 4.3, 4.8; 26 m; 23 June 1979; *Spheciospongia vesparium*; USNM 189161. — 125 ♂ (13 with bopyrids), 5.1-7.4; 88 ovig. ♀ (7 with bopyrids), 4.7-8.4; 22 juv., 2.0-4.5; 3 damaged; 26 m; 25 June 1979; *Spheciospongia vesparium*; MESC 6179-2191. — OTHER MATERIAL: 1 ♀, 4.8; 1 damaged adult, 5.3; West Flower Garden Bank; 27°52'N, 93°48'W; 25 m; 12 January 1972; dead coral head; TAMU 2-6257. — 4 juv., 3.4-4.8; off Cape San Blas, Florida; 27°04'N, 83°21'W; 48 m; 18 March 1885; *Albatross* Station 2409; SYNTYPES of *S. longicarpus approxima*; USNM 38398. — 2 ♂, 5.9, 6.0; off Crystal River, Florida; 28°57'N, 82°53'W; 6 m; 8 October 1969; Crystal River Station VI-1; FSBC I 7662. — 1 ♂, 6.2; 1 ovig. ♀, 6.0; off Crystal River, Florida; 28°55'N, 82°55'W; 9.1 m; 8 October 1969; Crystal River Station VII-1; FSBC I 7673.

Diagnosis: Rostrum (Figure 34a) slender, equal to or longer than ocular hoods, shallowly convex ventrally; ocular hoods narrowly triangular, with rounded tips. Pleuron of first abdominal somite of male (Figure 35a) bearing hooked tooth posteriorly, those of remaining 5 sharply acute posteroventrally. Telson (Figures 34b, 35d) broad anteriorly, narrow posteriorly, lateral margins usually concave in posterior 1/4; dorsal surface armed with 2 pairs of distinct but not large spines situated at about 1/4 and 1/2 length. Stylocerite (Figure 34a) extending to distal 1/4 of first segment of antennular peduncle. Scaphocerite considerably exceeding lateral spine of basicerite, development of blade variable; basicerite not angulate dorsally. Palm of major chela (Figure 32f, g) terminating distodorsally in single blunt tubercle, usually armed secondarily with slender spine directed distally. Fingers of minor chela (Figure 33a, b) deeply bidentate distally, tips arranged in plane of fingers, dactyl with dense fringe of curved hairs on extensor surface; length of carpus slightly more than 1/2 that of chela. Carpus of pereopod 2 (Figure 33c) usually with 5 articles. Dactyls of posterior 3 pereopods (Figure 33 e, g, i) with proximal tooth stronger than and slightly divergent from distal tooth. Lateral branch of uropod (Figures 34b, 35d) usually with 4-7 teeth proximal to movable spine.

Variation: Like the closely related species, *S. pandionis* and *S. goodei* (see Table 8, p. 87), *S. longicarpus* is variable in the development of the antennal blade (Williams, 1965), the number of uropodal teeth (Lyons et al., 1971), and the length of the carpus of the minor chela (Coutière, 1909). As in most species of *Synalpheus*, individuals sometimes have the rostrum or

the ocular hoods absent (Herrick, 1891; Wass, 1955). One specimen (FSBC I 28479) has an undifferentiated, lobate telson similar to that shown in Figure 11i (p. 30) of *S. brooksi*. Coutière (1909) noted that juveniles may have only four carpal articles on pereopod 2 and that the distodorsal spine of the major chela of adults may be indistinct. Although the fixed finger of the major chela is sometimes reduced relative to the length of the dactyl (Figure 35e, f), it never approaches the condition found in *S. disparodigitus*.

Color: Based on notes taken from live material from the Florida Middle Ground: Carapace, abdomen, telson, and uropods transparent straw yellow, speckled with dark chromatophores dorsally on carapace, especially in rostral region; ovaries muddy greenish brown; eggs reddish brown. Antennae, antennules, maxilliped 3, pereopods, and pleopods transparent straw yellow; major and minor pereopods 1 purplish brown on distal margins.

Hay and Shore (1918: 383) gave the color as "a translucent milky white; the tip of the large chela brown". This description was repeated by Verrill (1922), Williams (1965), and Christoffersen (1979), but none of the authors denoted this as the color of living material. Herrick (1891) also provided color notes, but it is uncertain whether they actually refer to *S. longicarpus*.

Size (CL in mm): Males, 5.0-8.4; ovigerous females, 4.7-9.3; juveniles, 1.9-5.0.

Habitat: Within sponges, principally *Spheciospongia vesparium* (Herrick, 1891; Hay and Shore, 1918; Pearse, 1932b; 1950; Abele, 1970; Chace, 1972), but also *Agelas dispar* (present study) and a large yellow sponge (Wass, 1955); in and around coral (Chace, 1972; Pequegnat and Ray, 1974); in colonies of *Zoanthus sociatus* (Ellis, 1767) (Schmitt, 1936).

Lyons et al. (1971) reported *S. longicarpus* from a salinity range of 22 to 35°/oo and from a temperature range of 14 to 29°C. Hourglass specimens were collected from bottom salinities ranging from 33.0 to 36.5°/oo and bottom temperatures ranging from 13.9 to 29.0°C. Ranges of the same parameters for Florida Middle Ground collections were 34.6 to 36.2°/oo and 22.0 to 26.0°C.

Distribution: Atlantic: North Carolina (Coutière, 1909; Hay and Shore, 1918; Pearse and Williams, 1951; Williams, 1965), South Carolina (Young, 1978), central eastern Florida (R. H. Gore, pers. comm.), Bahama Islands (Herrick, 1891; Pearse, 1950), and probably Brazil (Christoffersen, 1979); Gulf of Mexico: off western Florida (Coutière, 1909), Florida Middle Ground (present study), Crystal River (Lyons et al., 1971), Alligator Harbor (Wass, 1955), off Dog Island, Franklin County, Florida (Soto, 1972), West Flower Garden Bank (Pequegnat and Ray, 1974; ?Ray, 1974); Caribbean: Yucatan Peninsula (Coutière, 1909; Chace, 1972), Jamaica (Coutière, 1909), ?Haiti (Boone, 1930), Virgin Islands (Zimmer, 1913; Chace, 1972), Windward Islands (Chace, 1972), Barbados (Zimmer, 1913; Schmitt, 1924a), Netherlands Antilles (Coutière, 1909; Schmitt, 1936), Venezuela (Chace, 1956a). Distributed bathymetrically from less than 1 (Chace, 1972) to 73 m (present study).

Remarks: At the time Herrick (1891) described this species, the systematics of the Alpheidae were poorly understood. Some authors confused distinct species, even to the point of including several species in a type-series. For example, Coutière (1909) later recognized and described *S. pectiniger* from the type-series of *S. longicarpus*. Coutière (1898) himself figured three distinct species under the name *S. laevimanus longicarpus*. It is not certain which three species are figured in this publication, but, in 1899, three species which were later named *S.*

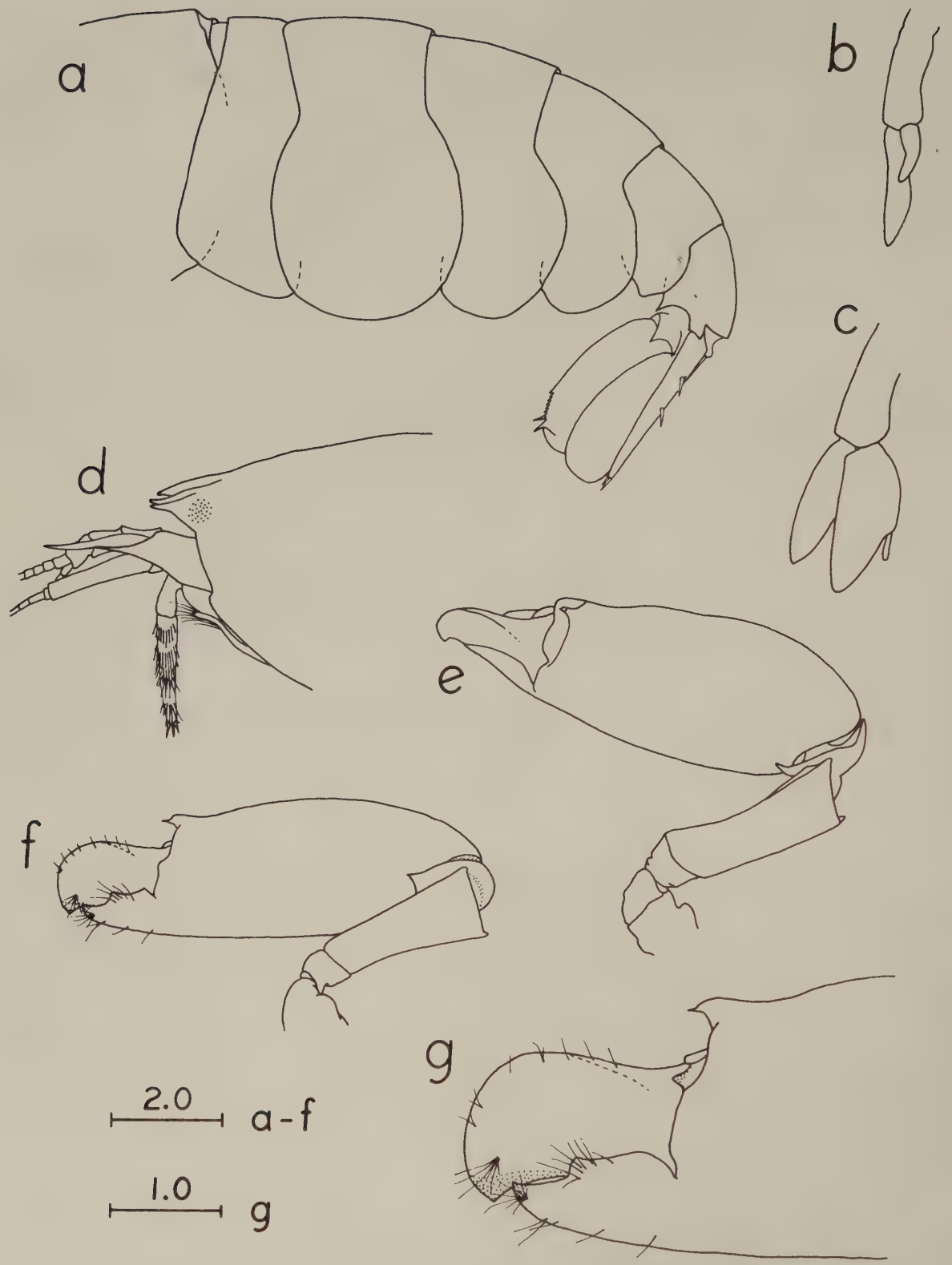

Figure 32. *Synalpheus longicarpus*, ovigerous female, CL 7.9, USNM 189161; a. abdomen; b. left pleopod 1; c. left pleopod 2; d. anterior region, lateral view; e. left major chela, dorsal view; f. same, lateral view; g. same, lateral view of distal portion.

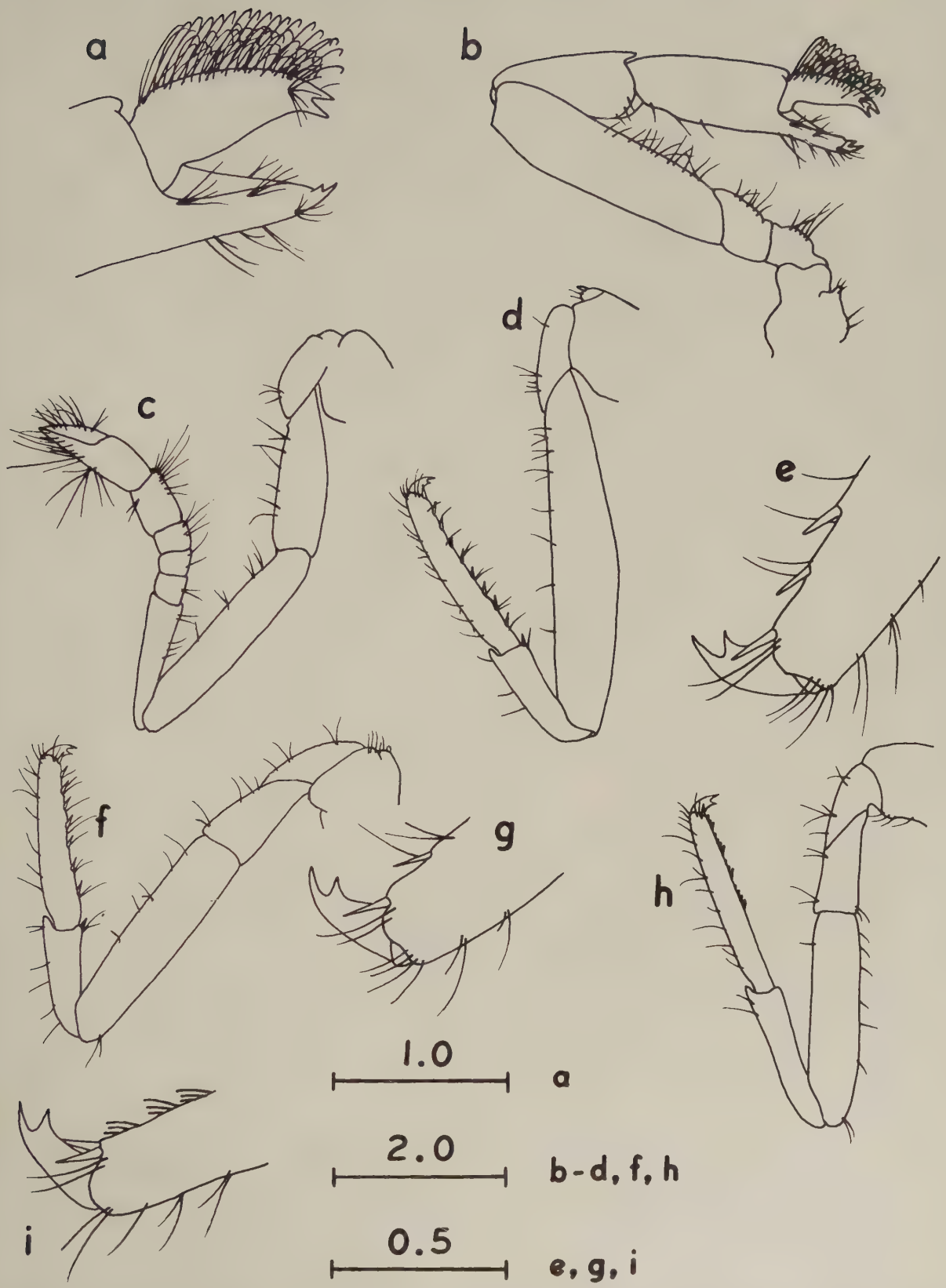

Figure 33. *Synalpheus longicarpus*, ovigerous female, CL 7.9, USNM 189161; a. right minor chela, distal region; b. right minor chela; c. left pereopod 2; d. left pereopod 3; e. same, dactyl; f. left pereopod 4; g. same, dactyl; h. left pereopod 5; i. same, dactyl.

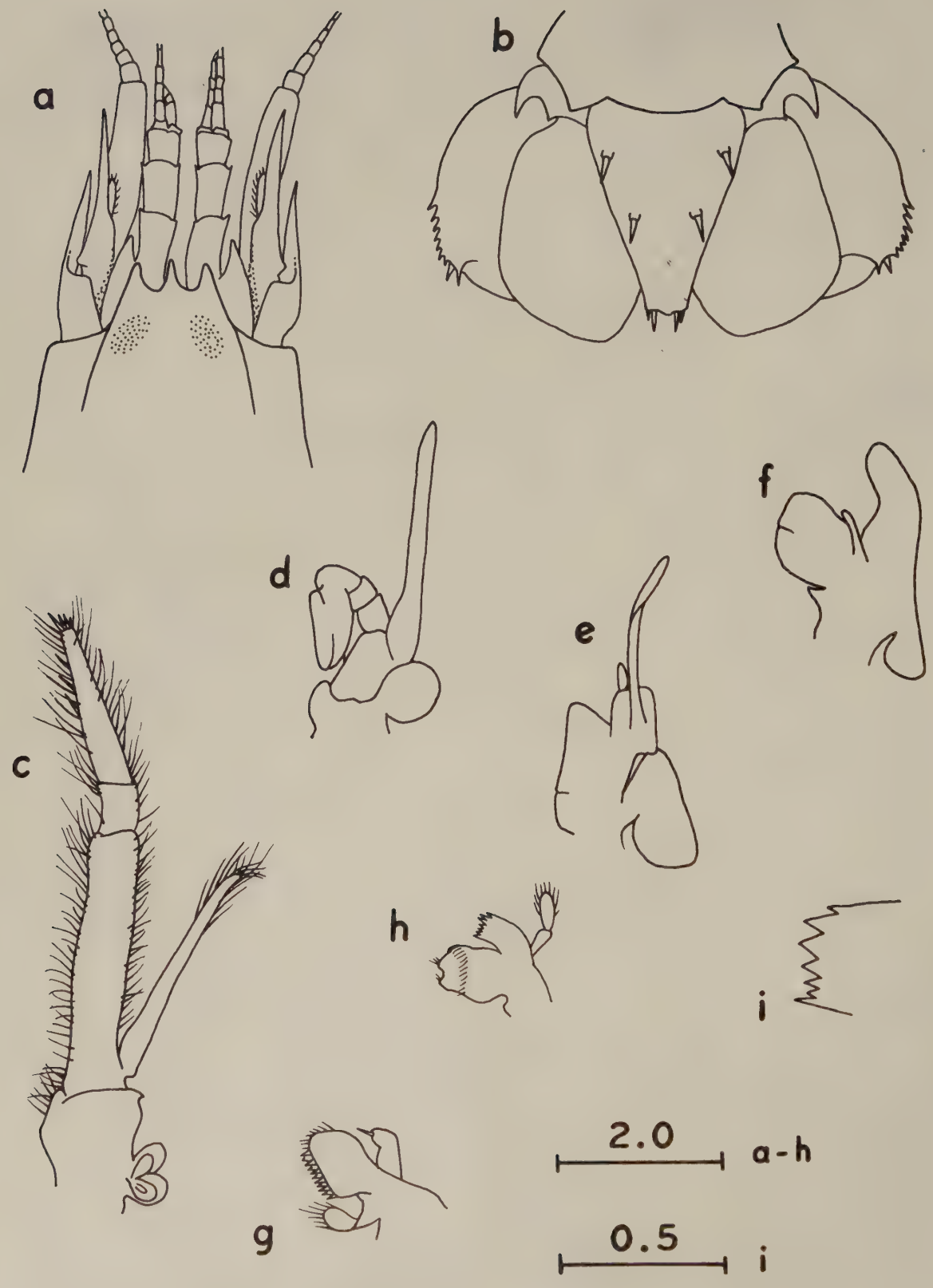

Figure 34. *Synalpheus longicarpus*, ovigerous female, CL 7.9, USNM 189161; a. anterior region, dorsal view; b. telson and uropods; c. left maxilliped 3; d. left maxilliped 2; e. left maxilliped 1; f. left maxilla 2; g. left maxilla 1; h. left mandible; i. same, incisor process.

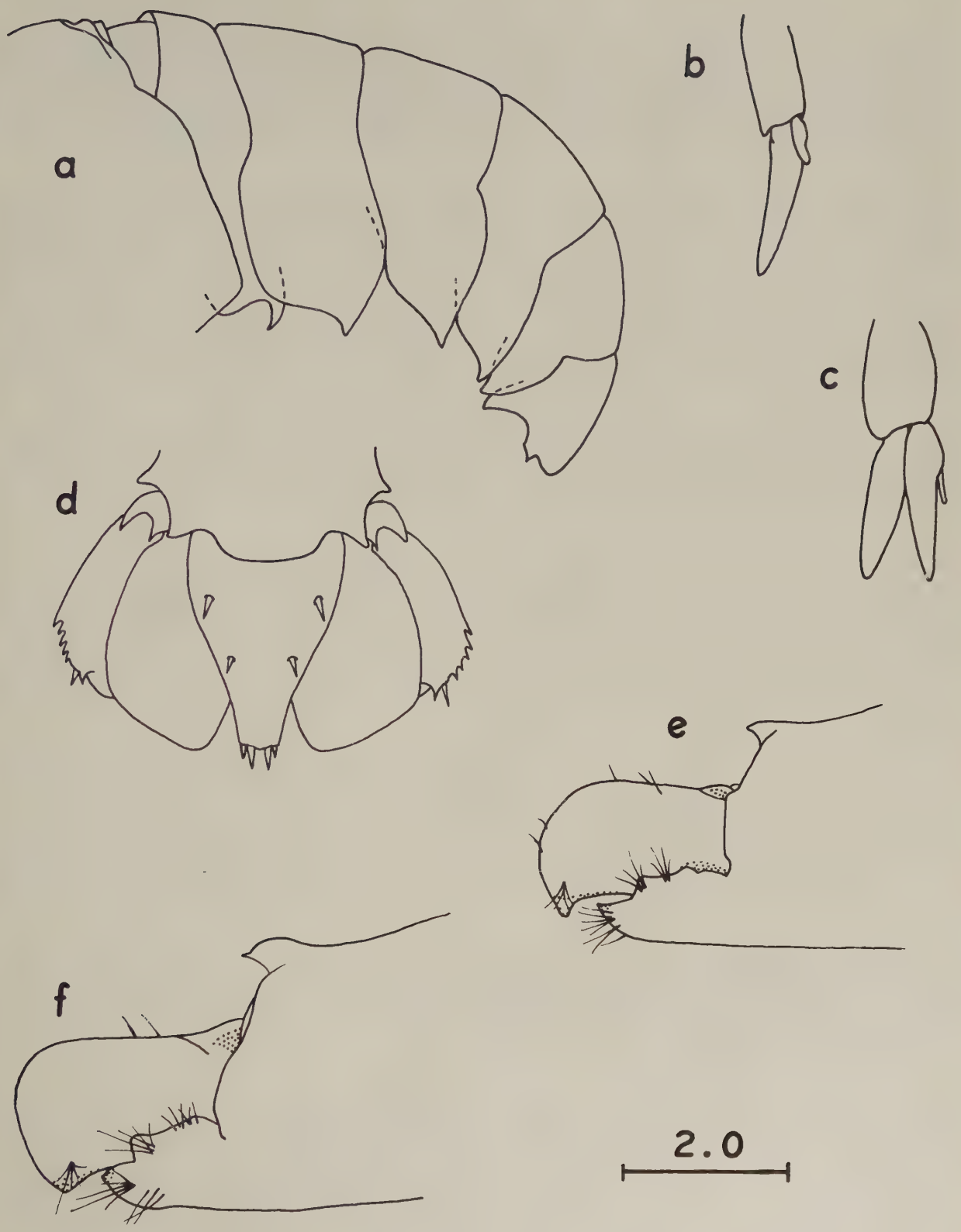

Figure 35. *Synalpheus longicarpus*, male, CL 7.0, USNM 189161; a. abdomen; b. left pleopod 1; c. left pleopod 2; d. telson and uropods. Ovigerous female, CL 8.9, USNM 189162; e. left major chela, distal region. Male, CL 7.3, MESC 6179-2191; f. left major chela, distal region.

brooksi, *S. herricki*, and *S. pectiniger* were treated as *S. longicarpus* β by Coutière (1899) (see Coutière, 1909). Typical *S. longicarpus* were labeled *S. longicarpus* α in the 1899 work. This changing concept of specific characters within *Synalpheus* led to confusion among later authors attempting to assign an identity to specimens figured in the older literature (Herrick, 1891; Coutière, 1898, 1899; Verrill, 1900, 1922; Rathbun, 1901).

Herrick (1891: 510, pl. 24, fig. 3) identified specimen No. 8 in his Table I (p. 385) as *Alpheus saulcyi* var. *brevicarpus*, but another figure (pl. 22, fig. 18), labeled only *A. saulcyi*, is also identified as specimen No. 8. Plate 24, Figure 3 shows a minor chela with a short carpus and with the tips of the fingers simple and lacking a tuft of hairs on the extensor margin of the dactyl, characters which agree well with *S. brevicarpus*, the species which characterizes the Brevicarpus group. Paradoxically, Plate 22, Figure 18 is of an antennular peduncle with a relatively short stylocerite, a character of the Gambarelloides group. Verrill (1922: pl. 34, fig. 4; pl. 36, fig. 4) reproduced these figures, labeling the former "*A. saulcyi* var. *brevicarpus*" and the latter "*S. longicarpus*?." It seems likely that, in addition to Herrick's confusion regarding the specific identity of his specimens, some of his figures were erroneously labeled. The identity of the specimen in Herrick's Plate 22, Figure 13, which he labeled *A. saulcyi*, is also questionable, having been identified as the same specimen No. 8.

Verrill (1922: pl. 34, fig. 5, 5a) also included illustrations of Herrick's (1891: pl. 24, fig. 2; pl. 22, fig. 14) specimen No. 9, which Verrill identified as *S. pectiniger*. This identification is doubtful, however, since a vestige of an antennal blade is present. Although the tridentate minor chela and the host, *Hircinia acuta* (=*Spheciospongia vesparium*), do suggest *S. pectiniger*, both Coutière (1909) and Chace (1972) specifically stated that *S. pectiniger* does not have even a rudimentary antennal blade. Again, the possibility of mislabeled figures exists.

Verrill (1922) remarked that the chela figured in his Plate 34, Figure 3 [after Herrick (1891: pl. 24, fig. 8), identified only as *A. saulcyi*, from "loggerhead" sponge] did not seem to be *S. longicarpus*, nor could it be identified with any described species. In fact, it closely resembles that of *S. pectiniger*. Other figures by Herrick (1891: pl. 24, figs. 4-9), two of which were included in Verrill (1922: pl. 36, fig. 5, 5a) as *S. pectiniger*?, are also of specimens identified only as *A. saulcyi* by Herrick; their specific identity is questionable.

Confusion regarding the identity of *S. longicarpus* has persisted. The specimens in the U.S. National Museum identified by Waldo Schmitt as *S. macclendoni* for Pearse (1932b) are actually *S. longicarpus*. The specimens identified as *S. herricki* by Lyons et al. (1971), Pequegnat and Ray (1974), and Ray (1974) are, likewise, *S. longicarpus*.

Christoffersen (1979) found that Brazilian populations of *S. pandionis* were indistinguishable from those of *S. longicarpus*. In Gulf of Mexico specimens, however, variability in the length of the lateral spine of the basicerite relative to that of the scaphocerite and in the length of the carpus of the minor chela are distributed around different means in the two species. In addition, the two species mature at different sizes and grow to different maximum lengths. Since these are the very characters found to be variable by Christoffersen (1979), the two species are best considered distinct pending comparison of specimens from throughout the species' range.

Synalpheus longicarpus approxima, like many of Coutière's subspecies, not only falls within the range of variation of the nominate subspecies, but also comes from the same locality.

The presence of *S. longicarpus* at Bermuda is unconfirmed. Although Chace (1972) reported the species from Bermuda, his 1937a faunal list does not include it, and Markham and McDermott (1981) reported it only questionably. The Bermudian records of Verrill (1900) and Rathbun (1901) are actually for *S. goodei*. Verrill (1922) clearly stated that *S. longicarpus* was not obtained at Bermuda.

The type-locality of *S. longicarpus* is usually given as: Bahamas, probably Nassau, New Providence (Williams, 1965; Chace, 1972; Christoffersen, 1979). The type-specimens could not be traced.

Herrick (1891) discussed and figured the larval development of *S. longicarpus*, but, as mentioned above, he may have included other species in this discussion. Herrick noted that larvae hatch in the adult form, but Coutière (1909) pointed out that the eggs are small and that the larvae are zoeae.

Coutière (1899; 1900; 1907; 1909) and Wass (1955) remarked upon reproductive anomalies in *S. longicarpus*. Both found excessive numbers of males, relatively few females with eggs, and reduction in the average size of specimens in overcrowded sponges, suggesting a density-dependent response.

Although Figure 36 indicates that *S. longicarpus* in the Hourglass study area are only slightly more abundant at the 37 m stations than at the 18 m stations, reference to Table 7 gives a more realistic image. Moreover, nearly all *S. longicarpus* taken from 18 m (Stations B, J) were collected in only three (night) samples, whereas samples from 37 m (Stations C, K) more consistently contained *S. longicarpus*, although in fewer numbers. Few individuals were taken from depths greater than 37 m. The abundance of loggerhead sponges noted by Joyce and Williams (1969) at Stations C and K is probably responsible for the apparent depth preference demonstrated by *S. longicarpus* in these collections.

Nearly as many females were present within the Hourglass study area as were males (99: 107). Virtually all females were ovigerous. Egg-bearing females were collected during every month except December. Juveniles were taken in January, April, and June through November. Year-round breeding is evident.

TABLE 7. MONTHLY CATCH OF *Synalpheus longicarpus* AT HOURGLASS STATIONS.

Synalpheus longicarpus																														
STA	1965					1966													1967											TOT
	A	S	O	N	D	J	F	M	A	M	J	J	J sp	A	S	O	N	D	J	J sp	F	M	A	M	J	J	A	S	O	N	
A																															
B_1							1																								1
B_2																	1														1
C_1		3	1	2		2		2	1	2		4				3	1			22	2		1				1	2			49
C_2								2	2	5	10			2	59		3	1					2	1	2		1		3		93
D_1																				2	1										3
D_2												1																			1
E																				1											1
I																															
J														18		21										9					48
K						6		2				2	20		1		3		3	2			21					1		3	64
L													1						1												2
M																															
TOT		3	1	2		8	1	6	3	7	10	7	21	20	60	24	8	1	4	27	3		24	1	2	9	1	2	5	3	263

Subscripts 1, 2, and SP represent regular (night), post (day), and supplementary (45 ft trawl) cruises.

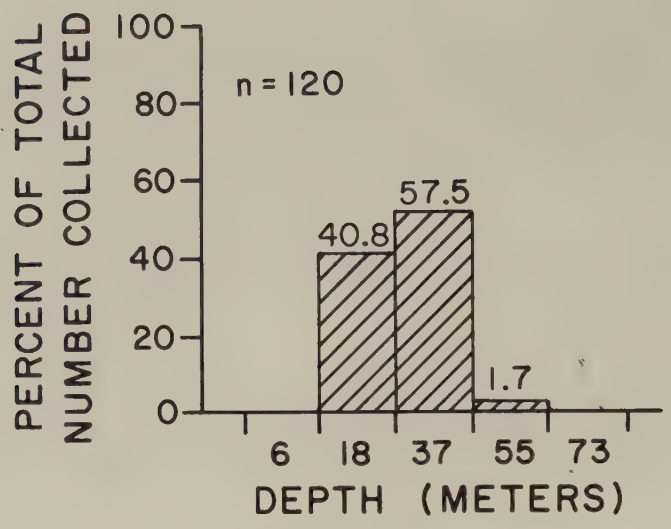

Figure 36. Relative abundance of *Synalpheus longicarpus* by depth during regular (night) sampling at Hourglass stations. Dredge and trawl samples combined; 45-ft trawl catches omitted.

Synalpheus macclendoni Coutière, 1910

Figures 37-39

Synalpheus mcclendoni Coutière, 1910, p. 487, fig. 3; Schmitt, 1924b, p. 81; 1930, p. 344; Chace, 1972, p. 95, figs. 33, 34; Ray, 1974, pp. 148, 149, figs. 133-135.

Not *Synalpheus mcclendoni*: Pearse, 1932b, pp. 119, 120; Arndt, 1933, pp. 248, 249; Westinga and Hoetjes, 1981, p. 148. [=*Synalpheus longicarpus* (Herrick, 1891)].

Material examined: 2 ♂, 2.6, 2.6; 2 juv., 1.5, 1.7; Freeport, Grand Bahama Island; 21-23 m; November 1975; diver-collected; *Agelas dispar*; MESC 6179-2192. — 2 juv., 1.7, 2.2; Freeport, Grand Bahama Island; 21-23 m; November 1975; diver-collected; *Agelas dispar*; MESC 6179-2193. — 5 ♂, 2.5-3.1; 2 ovig. ♀, 2.9, 3.2; 2 juv., 1.9, 2.2; Freeport, Grand Bahama Island; 21-23 m; November 1975, diver-collected; *Agelas dispar*; USNM 189162. — 3 ♂, 3.4-4.2; Dry Tortugas, Florida; summer, 1908; J. F. McClendon (coll.); SYNTYPES; USNM 40018.

Diagnosis: Rostrum and ocular hoods (Figure 37d) slender but well developed; rostrum longer than ocular hoods, strongly convex ventrally. Pleuron of first abdominal somite of male (Figure 37b) bearing hooked tooth posteriorly (sometimes reduced or absent), those of second, third, and fourth somites broadly rounded, that of fifth subrectangular, that of sixth acuminate. Telson (Figure 37c, f) broad anteriorly, narrower posteriorly, lateral margins almost straight; dorsal spines situated rather near margins, originating at about 1/4 and 3/5 length of telson. Stylocerite (Figure 37d) extending to distal margin of first segment of antennular peduncle. Scaphocerite considerably exceeding lateral spine of basicerite, blade well developed; basicerite not armed dorsally. Distodorsal end of palm of major chela with either stout spine (see Chace, 1972: 96, fig. 34b, c) or ill-defined spine-tipped lobe present (Figure 38j, k). Dactyl of minor chela (Figure 38h, i) with obscure tooth just proximal to well-defined terminal tooth, dense fringe of curved hairs present on extensor surface; fixed finger with single tooth; length of carpus about 1/3 that of chela. Carpus of pereopod 2 (Figure 39a) composed of 5 articles. Dactyls of posterior 3 pereopods (Figure 39c, e, g) with proximal tooth stronger than and slightly divergent from distal tooth. Lateral branch of uropod (Figure 37c, f) usually with single tooth proximal to movable spine.

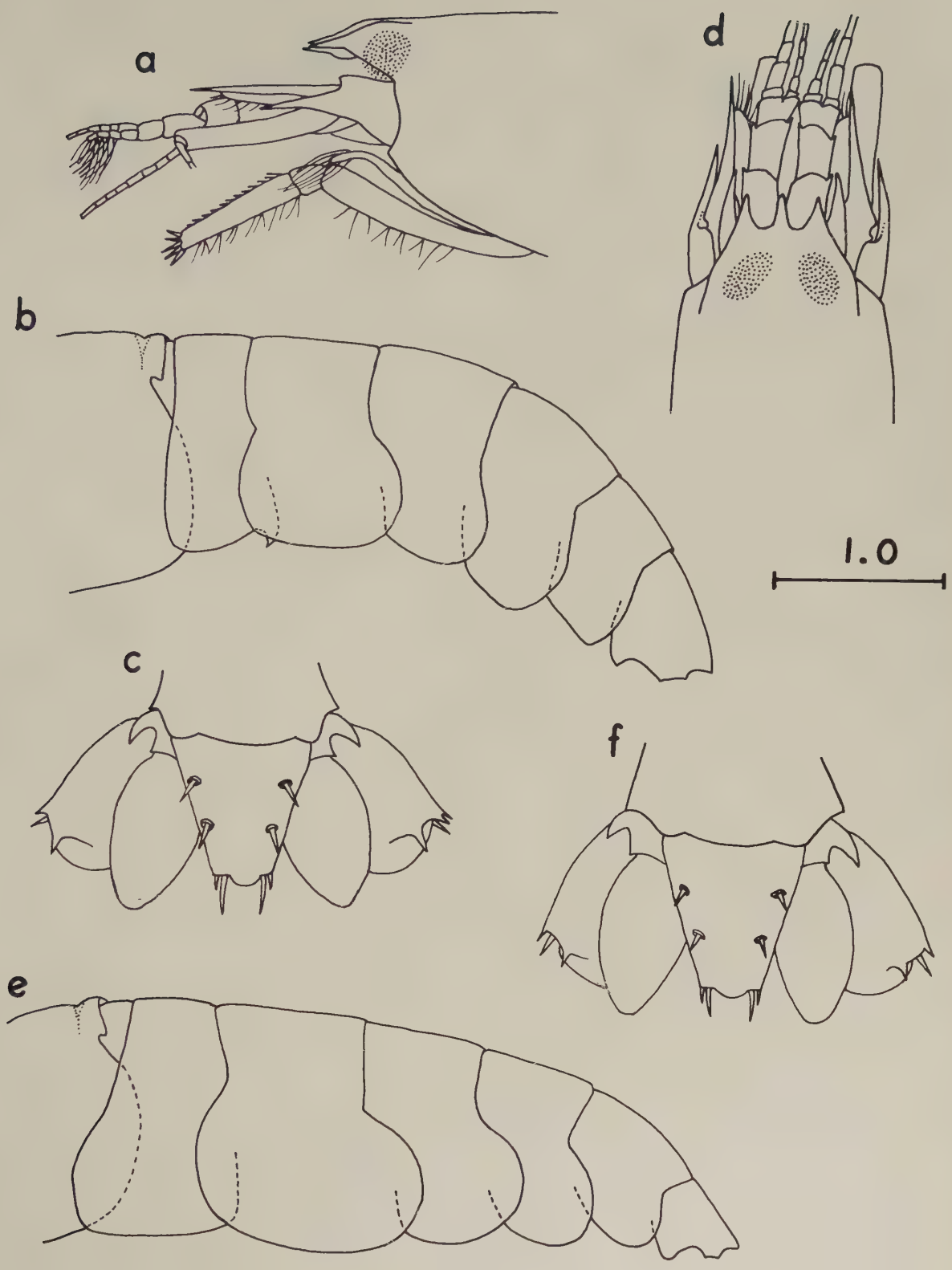

Figure 37. *Synalpheus macclendoni*, male, CL 3.0, USNM 189162; a. anterior region, lateral view; b. abdomen; c. telson and uropods. Male, CL 3.1, USNM 189162; d. anterior region, dorsal view. Ovigerous female, CL 2.9, USNM 189162; e. abdomen; f. telson and uropods.

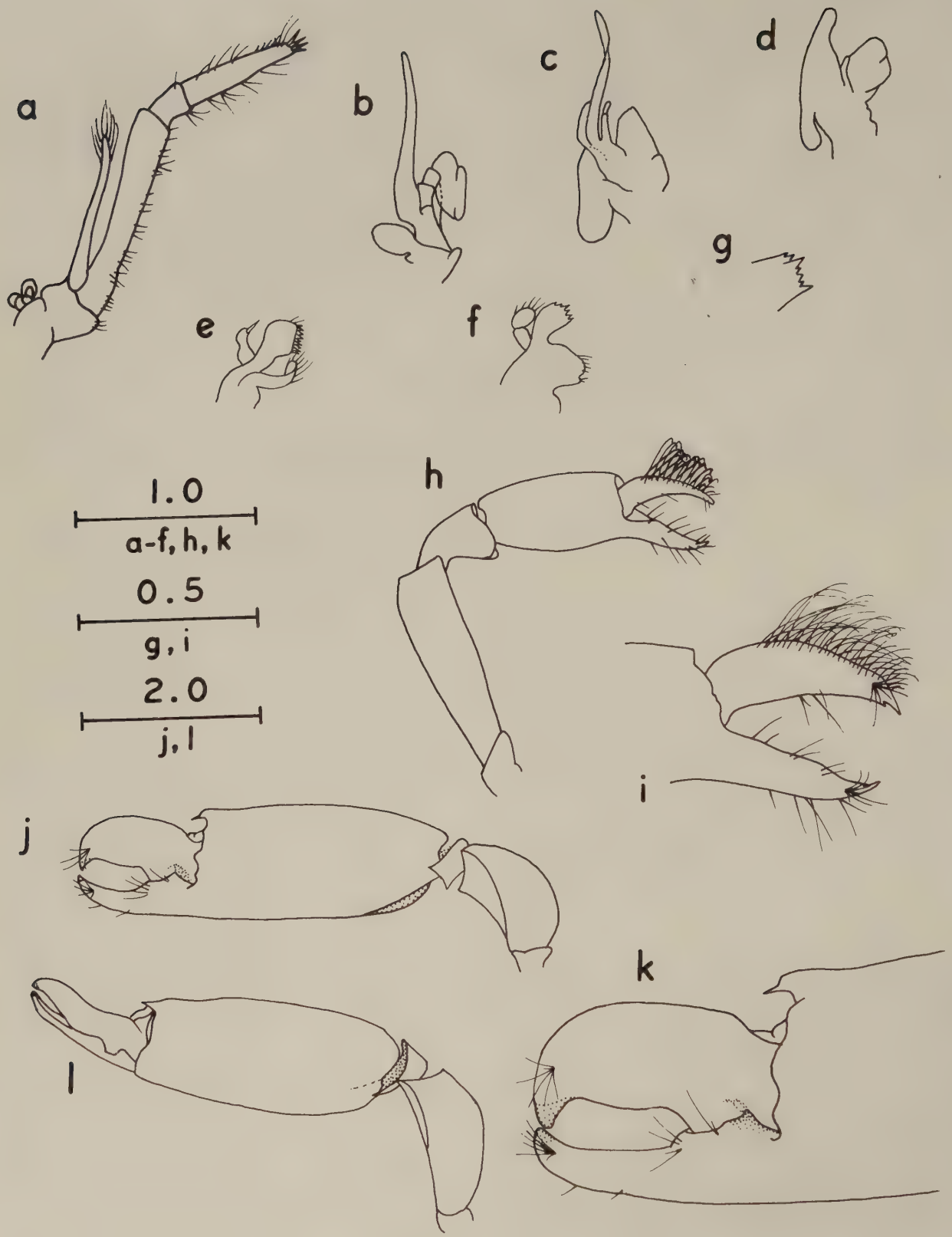

Figure 38. *Synalpheus macclendoni*, male, CL 3.0, USNM 189162; a. right maxilliped 3; b. right maxilliped 2; c. right maxilliped 1; d. right maxilla 2; e. right maxilla 1; f. right mandible; g. same, incisor process; h. right minor chela; i. same, distal portion. Detached, not assignable to a particular specimen; j. left major chela, lateral view; k. same, lateral view of distal portion; l. same; dorsal view.

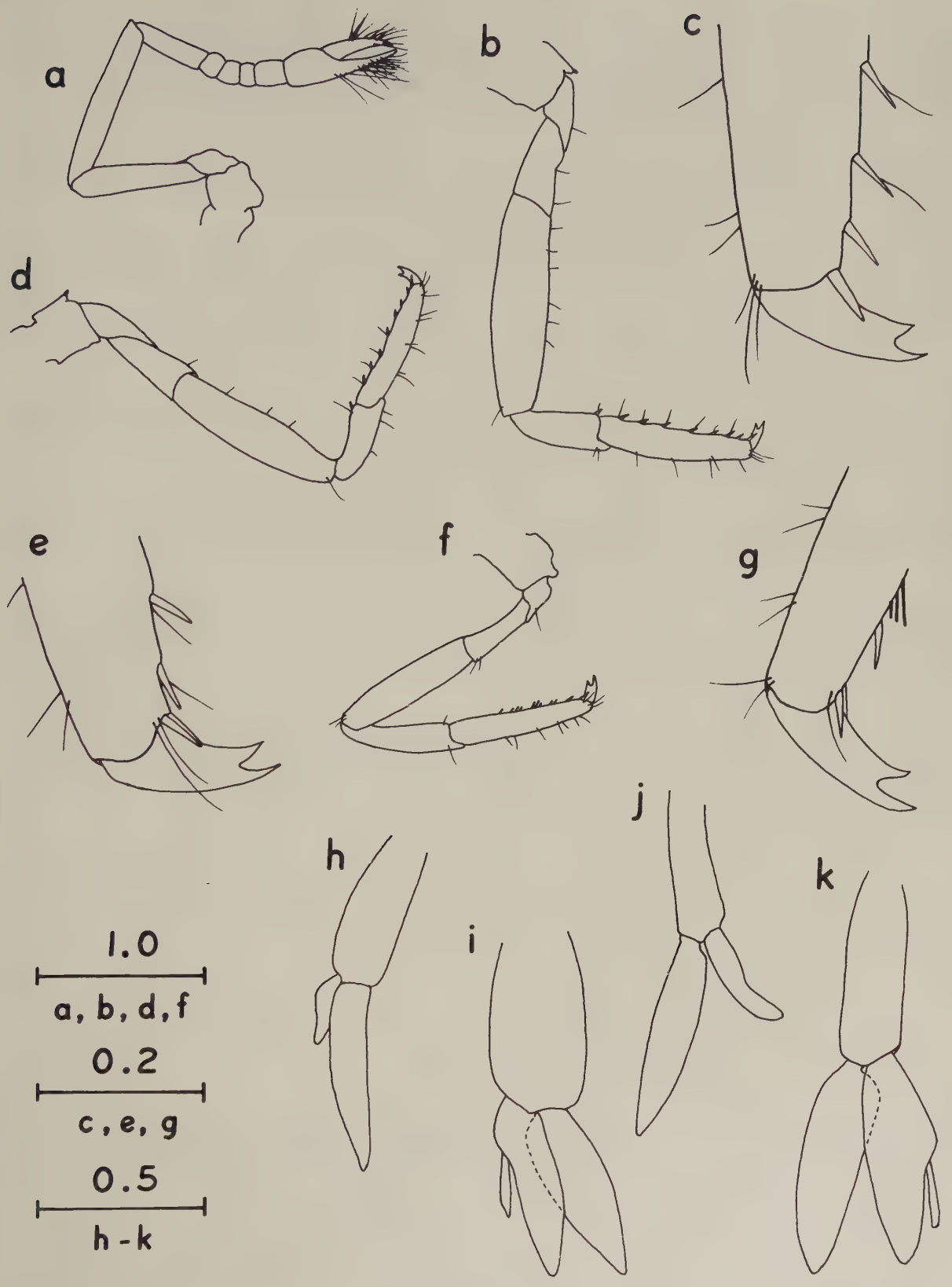

Figure 39. *Synalpheus macclendoni*, male, CL 3.0, USNM 189162; a. right pereopod 2; b. right pereopod 3; c. same, dactyl; d. right pereopod 4; e. same, dactyl; f. right pereopod 5; g. same, dactyl; h. right pleopod 1; i. right pleopod 2. Ovigerous female, CL 2.9, USNM 189162; j. left pleopod 1; k. left pleopod 2.

Variation: The specimens examined, including Coutière's syntypes, differ from Chace's (1972) Smithsonian-Bredin material in two respects. The distodorsal palmar spine of the major chela, instead of appearing regularly conical, is armed with a secondary spine (Figure 38k), and most males have the pleuron of the first abdominal somite strongly hooked posteriorly.

The figured male possesses two spines proximal to the movable spine on the lateral branch of the right uropod (Figure 37c) rather than the more usual single spine.

Color: "Quite colorless all over; fingers and anterior part of large chela pale ocher yellow overlaid and darkened with liver-brown to hazel chromatophores" (Schmitt, 1930: 344).

Size (CL in mm): Gulf of Mexico specimens: male syntypes, 3.4-5.2. Bahama Island specimens: males, 2.5-3.1; ovigerous females, 2.9-3.0; juveniles, 1.5-2.2.

Habitat: In sponges and probably from eroded coral (Chace, 1972). The Bahamian specimens were taken from individuals of an orange demosponge, *Agelas dispar*.

Distribution: Atlantic: Grand Bahama Island; Gulf of Mexico: Dry Tortugas (Coutière, 1910) and Isla de Lobos Reef, off Veracruz (Ray, 1974); Caribbean: Yucatan Peninsula, Windward Islands (Chace, 1972) and Barbados (Schmitt, 1924b); from depths of 1 to 23 m.

Remarks: The Bahamian material approaches *S. sanctithomae* Coutière, 1909, especially in the form of the major chela and the relative length of the stylocerite, but the narrowness of the ocular hoods and the breadth of the telson posteriorly leave little doubt of their identity.

The specimens of *S. macclendoni* from *Spheciospongia vesparium* reported by Pearse (1932b) are *S. longicarpus*. *Synalpheus longicarpus*, *S. brooksi*, and *S. pectiniger* are the usual alpheid inhabitants of loggerhead sponges from the eastern Gulf of Mexico.

Synalpheus pandionis Coutière, 1909

Figures 40-43

Synalpheus laevimanus parfaiti: Rathbun, 1901, p. 110 [in part]. [Not *Alpheus laevimanus* Heller, 1862, =*Synalpheus gambarelloides* (Nardo, 1847); not *Synalpheus laevimanus parfaiti* Coutière, 1898].

Synalpheus grampusi Coutière, 1909, pp. 62-67, fig. 36; Chace, 1956b, p. 13.

Synalpheus pandionis Coutière, 1909, pp. 67-69, fig. 39; Zimmer, 1913, pp. 385, 386, figs. C-E; Schmitt, 1924a, p. 68; 1924b, p. 81; 1935, p. 149; Chace, 1972, pp. 102, 103; Pequegnat and Ray, 1974, p. 248, figs. 53e [after Coutière, 1909], 54; Ray, 1974, pp. 157-163, figs. 142-149; Heck, 1977, p. 338; Rodriguez, 1980, pp. 161, 162; Gore, 1981, p. 151.

Synalpheus pandionis extentus Coutière, 1909, p. 69, fig. 40; Chace, 1956a, p. 149.

Synalpheus pandionis pandionis: Chace, 1956a, p. 149.

Synalpheus longicarpus: Christoffersen, 1979, pp. 344-350, [?]figs. 23-27 [? in part]. [Not *Alpheus saulcyi* var. *longicarpus* Herrick, 1891].

Material examined: HOURGLASS STATION B: 1 ♂, 5.0; 2 May 1966; trawl; FSBC I 28518.

— 1 ♂, 4.4; 3 ovig. ♀, 3.8-6.0; 6 June 1966; trawl; FSBC I 28519. — 4 ♂, 4.2-4.9; 2 ovig. ♀, 5.1, 5.4; 10 July 1966; trawl; FSBC I 28520. — 1 ♂, 4.8; 1 ovig. ♀, 5.8; 10 August 1966; trawl; FSBC I 28521. — 2 ovig. ♀, 4.4, 5.2; 2 adolescents, 3.3, 3.6; 1 damaged; 10 August 1966; dredge; FSBC I 28522. — 1 ovig. ♀, 5.5; 31 August 1966; trawl; FSBC I 28523. — 3 ♂, 4.0-4.8; 1 ovig. ♀, 4.2; 8 September 1966; trawl; FSBC I 28524. — 2 ♂, 4.1, 4.4; 2 ovig. ♀, 4.5, 5.6; 8 September 1966; dredge; FSBC I 28525. — 1 ovig. ♀, 3.8; 18 October 1966; dredge; FSBC I 28526. — 11, 4.8; 1 ovig. ♀, 5.2; 3 adolescents (2 ovig., 3.1, 3.6), 3.1-3.6; 1 December 1966; trawl; FSBC I 28527. — 3 ♂, 4.1-5.1; 2 ovig. ♀, 4.8, 5.8; 13 December 1966; trawl; FSBC I 28528. — 1 ♂, 4.7; 1 ovig. ♀, 5.5; 2 March 1967; trawl; FSBC I 28529. — 1 ♂, 3.8; 2 March 1967; dredge; FSBC I 28530. — 1 ovig. ♀, 5.4; 3 April 1967; dredge; FSBC I 28531. — 2 ♂, 3.8, 4.5; 1 ovig. ♀, 4.6; 11 April 1967; trawl; FSBC I 28532. — 1 ♂, 4.4; 2 ovig. ♀, 5.0, 5.7; 2 adolescents (1 ovig., 3.3), 3.5; 2 juv., 2.4, 2.8; 11 May 1967; trawl; FSBC I 28533. — 1 ♂ (with hemiarthrine), 4.1; 20 May 1967; dredge; FSBC I 23881. — 3 ♂, 4.2-4.5; 3 ovig. ♀, 4.3-5.2; 20 May 1967; dredge; FSBC I 28534. — 1 ♂, 4.4; 2 ovig. ♀, 5.1, 5.4; 2 June 1967; dredge; FSBC I 28535. — 1 ♂, 4.8; 20 June 1967; dredge; FSBC I 28536. — 1 ♂, 5.0; 1 ovig. ♀, 5.6; 11 August 1967; trawl; FSBC I 28537. — 1 ovig. ♀, 7.1; 5 October 1967; dredge; FSBC I 28538. — HOURGLASS STATION C: 1 ovig. ♀, 5.8; 20 February 1966; dredge; FSBC I 28539. — 1 juv., 2.8; 27 March 1966; dredge; FSBC I 28540. — 1 ovig. ♀, 5.1; 16 April 1966; trawl; FSBC I 28541. — 1 ovig. ♀, 5.0; 16 April 1966; dredge; FSBC I 28542. — 1 ♂, 3.9; 2 May 1966; trawl; FSBC I 28543. — 1 juv., 2.9; 19 November 1966; dredge; FSBC I 28544. — 3 ♂, 5.2-5.5; 3 ovig. ♀, 4.0-5.8; 2 adolescents (both with bopyrids), 3.1, 3.7; 2 juv., 2.7, 2.9; 1 December 1966; dredge; USNM 189164. — 2 ovig. ♀ (1 damaged), 4.8; 2 adolescents (1 ovig., 3.3), 3.6; 6 January 1967; dredge; FSBC I 28545. — 1 ovig. ♀, 5.8; 20 January 1967; trawl; FSBC I 28546. — 1 ovig. ♀, 5.8; 25 January 1967; trawl; FSBC I 28547. — 1 ♂, 5.3; 1 ovig. ♀, 4.8; 2 juv., 2.3, 2.4; 5 February 1967; trawl; FSBC I 28548. — 1 ♂, 5.5; 5 February 1967; dredge; FSBC I 28549. — 1 juv., 2.6; 3 April 1967; trawl; FSBC I 28550. — 1 ♂, 4.4; 3 April 1967; dredge; FSBC I 28551. — 1 ♂, 4.8; 20 May 1967; dredge; FSBC I 28552. — 1 ovig. ♀, 6.0; 31 August 1967; trawl; FSBC I 28553. — 2 ♂, 4.2, 5.1; 2 ovig. ♀, 4.3, 6.0; 11 September 1967; dredge; FSBC I 28554. — 2 ♂, 4.0, 4.8; 21 November 1967; dredge; FSBC I 28555. — HOURGLASS STATION D: 2 ♂, 5.5, 5.5; 1 ovig. ♀, 6.2; 20 November 1965; trawl; FSBC I 28556. — 1 ♂, 5.0; 1 juv., 2.5; 4 January 1966; dredge; FSBC I 28557. — 1 ♂, 4.3; 1 ovig. ♀, 5.0; 1 juv., 3.3; 11 July 1966; dredge; FSBC I 28558. — 2 juv. (1 with infertile eggs, 3.1), 2.8; 9 November 1966; trawl; FSBC I 28559. — 1 adolescent, 3.4; 20 November 1966; trawl; FSBC I 28560. — 1 ♂ (with bopyrid), 4.1; 14 December 1966; trawl; FSBC I 23879. — 1 juv., 2.5; 14 December 1966; trawl; FSBC I 28561. — 1 ovig. adolescent, 3.8; 21 January 1967; dredge; FSBC I 28562. — 1 ♂, 3.8; 15 March 1967; trawl; FSBC I 28563. — 1 ovig. adolescent, 3.3; 1 juv., 2.8; 4 April 1967; trawl; FSBC I 28564. — 1 ♂, 4.7; 1 ovig. ♀, 5.6; 4 April 1967; dredge; FSBC I 28565. — 1 juv., 3.3; 21 May 1967; trawl; FSBC I 28566. — 1 juv., 2.8; 21 June 1967; trawl; FSBC I 28567. — 1 ovig. ♀, 4.7; 21 June 1967; dredge; FSBC I 28568. — 1 juv., 3.0; 1 September 1967; trawl; FSBC I 28569. — 1 juv., 3.3; 12 September 1967; trawl; FSBC I 28570. — 1 juv., 2.1; 12 September 1967; dredge; FSBC I 28571. — 2 juv. (1 with infertile eggs, 2.8), 2.5; 6 October 1967; trawl; FSBC I 28572. — HOURGLASS STATION E: 1 ♂, 4.8; 3 July 1966; trawl; FSBC I 28573. — 2 adolescents (1 ovig., 3.1), 3.1; 26 January 1967; trawl; FSBC I 28574. — 1 ♂, 4.3; 1 ovig. ♀, 4.8; 2 August 1967; dredge; FSBC I 28575. —HOURGLASS STATION I: 2 ♂, 4.7, 4.7; 5 August 1966; trawl; FSBC I 28576. — 1 ♂, 4.9; 2 ovig. ♀, 5.7, 6.0; 4 September 1967; dredge; FSBC I 8184. — HOURGLASS STATION J: 1 ♂, 3.8; 11 April 1966; dredge; FSBC I 17615. — 2 ovig. ♀, 4.4, 5.3; 11 May 1966; trawl; FSBC I 28577. — 2 ovig. ♀, 5.3, 5.6; 12 June 1966; dredge; FSBC I 28578. — 1 juv., 2.6; 21 July 1966; trawl; FSBC I 28579. — 2 ovig. ♀, 4.9, 5.7; 5 August 1966; dredge; FSBC I 28580. — 4 ♂, 4.0-6.6; 4 ovig. ♀, 5.0-6.3; 2 adolescents (1 ovig., 3.8), 3.8; 2 juv., 2.3, 3.2; 30 January 1967; trawl; FSBC I 28581. — 1 ♂, 3.9; 2 ovig. ♀, 4.0, 4.8; 2 juv., 2.6, 3.0; 8 March 1967; dredge; FSBC I 28582. — 2 ♂, 3.8, 4.3; 1 ovig. ♀, 4.3; 14 November 1967; trawl; FSBC I 28583. — HOURGLASS STATION K: 1 adolescent, 3.5; 5 July 1966; dredge; FSBC I

28584. — 1 ♂, 4.4; 1 ovig. ♀, 5.1; 1 juv., 2.1; 15 February 1967; trawl; FSBC I 28585. — 1 ovig. ♀, 5.3; 8 March 1967; dredge; FSBC I 28586. — 1 adolescent, 3.4; 7 April 1967; dredge; FSBC I 28587. — 1 juv., 2.3; 4 September 1967; trawl; FSBC I 28588.— HOURGLASS STATION L: 1 ♂, 4.7; 1 ovig. ♀, 5.3; 7 August 1965; dredge; FSBC I 28589. — 1 ovig. ♀, 4.9; 4 September 1965; trawl; FSBC I 28590. — 1 ovig. ♀, 5.7; 4 September 1965; dredge; FSBC I 28591. — 2 ♂, 4.9, 5.0; 13 October 1965; trawl; FSBC I 28592. — 1 juv., 2.3; 13 November 1965; trawl; FSBC I 28593. — 1 juv., 2.9; 14 January 1966; trawl; FSBC I 28594. — 1 ♂, 4.9; 15 February 1966; trawl; FSBC I 2053. — 1 ♂, 5.5; 1 ovig. ♀, 5.6; 1 juv., 3.3; 22 March 1966; trawl; FSBC I 28595. — 2 ovig. ♀, 5.5, 6.2; 22 March 1966; dredge; FSBC I 28596. — 1 ♂, 4.9; 2 ovig. ♀, 5.3, 5.5; 12 April 1966; trawl; FSBC I 28597. — 2 ovig. ♀, 5.7, 6.7; 12 April 1966; dredge; FSBC I 28598. — 3 ovig. ♀, 4.6-6.0; 12 May 1966; trawl; FSBC I 28599. — 1 ♂, 5.4; 13 June 1966; dredge; FSBC I 28600. — 2 ♂, 5.3, 5.3; 1 ovig. ♀, 4.5; 6 July 1966; trawl; FSBC I 28601. — 3 ♂, 4.3-5.3; 2 ovig. ♀, 5.0, 5.3; 6 July 1966; dredge; FSBC I 28602. — 5 ♂, 4.8-5.2; 3 ovig. ♀, 5.2-5.5; 2 adolescents (1 ovig., 3.0), 3.5; 6 August 1966; trawl; FSBC I 28603. — 1 ♂, 5.1; 2 ovig. ♀, 4.6, 5.3; 1 adolescent, 3.6; 6 juv. (1 with infertile eggs, 2.7), 2.1-2.9; 6 August 1966; dredge; FSBC I 28604. —3 ♂, 4.2-4.9; 2 ovig. ♀, 5.3, 5.8; 1 juv., 3.2; 5 September 1966; trawl; FSBC I 28605. — 1 ovig. ♀ (with hemiarthrine), 5.3; 5 September 1966; dredge; FSBC I 23885. — 7 ♂, 3.8-5.5; 12 ovig. ♀ (1 with hemiarthrine), 3.8-6.2; 2 adolescents (1 ovig., 3.3), 3.3; 12 juv., 1.5-3.1; 5 September 1966; dredge; FSBC I 28606. — 4 ♂, 4.2-5.4; 3 ovig. ♀, 5.4-5.8; 1 juv., 3.0; 13 October 1966; trawl; FSBC I 28607. — 1 ♂, 4.4; 1 ovig. ♀, 4.1; 3 juv., 1.0-2.6; 13 October 1966; dredge; FSBC I 28608. — 8 ♂, 4.1-5.8; 12 ovig. ♀, 4.6-6.1; 2 adolescents, 3.3, 3.7; 1 juv., 3.0; 13 November 1966; trawl; USNM 189165. — 1 adolescent (with bopyrid), 3.3; 13 November 1966; dredge; FSBC I 23873. — 1 ♂, 4.3; 2 ovig. ♀, 4.9, 5.2; 3 adolescents (2 ovig., 3.4, 3.5), 3.2; 3 juv., 2.5-3.0; 13 November 1966; dredge; FSBC I 28609. — 1 ♂, 4.3; 5 ovig. ♀, 4.2-5.9; 2 juv., 2.5, 3.3; 7 December 1966; trawl; FSBC I 28610. — 7 ♂, 3.8-5.2; 7 ovig. ♀, 3.9-6.2; 5 adolescents (4 ovig., 3.0-3.9), 3.5; 7 juv. (1 with infertile eggs, 2.8), 1.8-3.1; 7 December 1966; dredge; FSBC I 28611. — 1 ♀ (with bopyrid), 6.1; 13 January 1967; trawl; FSBC I 23874. — 11 ♂, 4.0-4.8; 8 ovig. ♀, 4.4-5.4; 3 adolescents, 3.5-3.8; 3 juv., 2.8-3.0; 13 January 1967; trawl; FSBC I 28612. — 6 ♂, 3.8-5.4; 5 ovig. ♀, 4.3-5.8; 2 juv., 2.8, 2.9; 13 January 1967; dredge; FSBC I 28613. — 1 ♂, 4.5; 1 ovig. ♀, 5.0; 1 juv., 2.2; 31 January 1967; trawl; FSBC I 28614. — 8 ♂, 4.1-5.3; 3 ovig. ♀, 4.9-6.3; 3 adolescents (2 ovig., 3.4, 3.5), 3.3; 16 February 1967; trawl; FSBC I 28615. — 8 ♂, 4.9-5.3; 7 ovig. ♀, 3.8-6.3; 3 adolescents (1 ovig., 3.2), 3.2-3.5; 8 juv., 2.2-3.3; 16 February 1967; dredge; FSBC I 28616. — 1 ♂, 4.1; 3 ovig. ♀, 4.3-5.0; 1 juv., 2.3; 8 April 1967; trawl; FSBC I 28617. — 2 ♂, 4.3, 4.9; 2 ovig. ♀, 4.2, 4.6; 5 juv., 2.3-2.8; 8 April 1967; dredge; FSBC I 28618. — 7 adolescents (2 with bopyrids; 1 ovig., 3.5), 3.3-3.8; 2 juv., 2.6, 2.8; 16 May 1967; trawl; FSBC I 28619. — 1 adolescent, 3.4; 16 May 1967; dredge; FSBC I 28620. — 4 ♂, 3.8-5.0; 2 ovig. ♀, 4.4, 5.0; 7 June 1967; trawl; FSBC I 28621. — 1 ♂, 4.2; 1 ovig. ♀, 4.1; 7 June 1967; dredge; FSBC I 28622. — 2 ♂, 4.0, 4.4; 2 ovig. ♀, 4.2, 4.8; 4 adolescents (1 ovig., 3.9), 3.3-3.9; 2 juv., 2.3, 2.8; 6 July 1967; trawl; FSBC I 28623. — 4 ♂ (1 with bopyrid), 4.7-5.6; 4 ovig. ♀, 4.7-5.9; 2 adolescents (1 ovig., 3.7), 3.9; 2 juv., 2.6, 3.1; 8 August 1967; trawl; FSBC I 28624. — 2 ♂, 4.1, 4.7; 3 ovig. ♀, 5.0-5.3; 1 juv., 3.2; 5 September 1967; trawl; FSBC I 28625. — 1 ♂, 3.8; 5 September 1967; dredge; FSBC I 28626. — 2 ♂, 4.2, 4.3; 2 ovig. ♀, 4.6, 5.2; 5 adolescents (2 ovig., 3.7, 3.8), 3.5-3.8; 2 juv., 1.4, 3.0; 12 October 1967; trawl; FSBC I 28627. — 2 ♂, 3.9, 4.7; 1 ovig. ♀, 5.3; 1 ♀, 4.2; 12 October 1967; dredge; FSBC I 28628. — 1 ♂, 4.6; 1 ovig. ♀, 5.9; 1 juv., 3.1; 15 November 1967; trawl; FSBC I 28629. — 1 ♂, 5.1; 1 juv., 1.8; 15 November 1967; dredge; FSBC I 28630. — HOURGLASS STATION M: 1 ♂, 5.2; 14 January 1966; trawl; FSBC I 28631. — 1 ♂, 5.3; 14 January 1966; dredge; FSBC I 28632. — 6 ♂, 4.7-5.3; 1 ovig. ♀, 5.2; 15 February 1966; trawl; FSBC I 28633. — 1 ♀ (with bopyrid), 4.3; 12 April 1966; trawl; FSBC I 23875. — 1 ♂, 4.3; 12 April 1966; dredge; FSBC I 28634. — 1 ♂, 3.8; 1 ovig. ♀, 5.1; 12 May 1966; trawl; FSBC I 28635. — 4 ♂, 5.0-5.6; 1 ovig. ♀, 5.6; 1 adolescent, 3.5; 13 June 1966; trawl; FSBC I 28636. — 3 ♂, 4.7-4.8; 1 ovig. ♀, 5.8; 2 adolescents, 3.2, 3.5; 1 juv., 3.0; 13 June 1966; dredge; FSBC I 28637. — 1 ♂, 4.5; 1 ovig.

♀, 5.3; 6 July 1966; trawl; FSBC I 28638. — 1 ovig. ♀, 4.2; 22 July 1966; trawl; FSBC I 28639. — 2 ♂, 4.8, 4.8; 2 ovig. ♀, 5.4, 5.7; 6 August 1966; trawl; FSBC I 28640. — 1 ovig. ♀, 6.3; 6 August 1966; dredge; FSBC I 28641. — 1 ovig. ♀, 5.8; 1 adolescent, 3.4; 5 September 1966; trawl; FSBC I 28642. — 3 ♂, 4.3-5.4; 1 ovig. ♀, 4.9; 3 adolescents, 3.3-3.7; 6 juv., 2.1-2.6; 5 September 1966; dredge; FSBC I 28643. — 2 juv., 2.2, 3.0; 13 October 1966; trawl; FSBC I 28644. — 1 juv., 2.6; 13 November 1966; trawl; FSBC I 28645. — 2 ♀ (1 with hemiarthrine), 3.8, 4.3; 1 juv., 2.2; 13 November 1966; dredge; FSBC I 28646. — 1 ♂, 3.8; 7 December 1966; trawl; FSBC I 28647. — 2 ♂ (damaged); 1 ovig. ♀ (damaged); 7 December 1966; dredge; FSBC I 28648. — 2 adolescents (1 ovig., 3.2), 3.2; 13 January 1967; dredge; FSBC I 28649. — 1 ♂, 5.7; 2 ovig. ♀, 5.3, 6.3; 2 juv., 2.0, 2.7; 16 February 1967; trawl; FSBC I 28650. — 1 ovig. adolescent, 3.2; 1 juv., 2.9; 16 February 1967; dredge; FSBC I 28651. — 3 ♂, 4.2-5.2; 6 ovig. ♀, 4.3-5.8; 4 adolescents (2 ovig., 3.3, 3.4), 3.3-3.9; 3 juv., 2.7-3.2; 9 March 1967; dredge; FSBC I 28652. — 4 ♂, 4.1-5.7; 3 ovig. ♀, 4.6-6.1; 1 adolescent, 3.5; 1 juv., 2.2; 8 April 1967; trawl; FSBC I 28653. — 2 ♂, 4.7, 4.8; 8 April 1967; dredge; FSBC I 28654. — 4 ♂, 4.3-5.2; 4 ovig. ♀, 3.8-6.3; 4 juv., 2.1-3.3; 16 May 1967; trawl; FSBC I 28655. — 1 ♂, 4.0; 2 adolescents (1 ovig., 3.8), 3.7; 7 June 1967; dredge; FSBC I 28656. — 4 ♂, 4.1-5.2; 3 ovig. ♀, 4.7-6.6; 5 adolescents (1 ovig., 3.5), 3.1-3.7; 6 July 1967; trawl; FSBC I 28657. — 3 ♂, 4.3-5.0; 4 ovig. ♀, 4.0-5.7; 1 juv., 2.9; 6 July 1967; dredge; FSBC I 28658. — 2 ♂, 4.8, 4.8; 2 ovig. ♀, 5.4, 5.6; 6 juv., 2.5-3.3; 8 August 1967; trawl; FSBC I 28659. — 1 ♂, 5.2; 8 August 1967; dredge; FSBC I 28660. — 2 ovig. ♀, 4.7, 4.8; 3 juv., 2.4-3.2; 5 September 1967; trawl; FSBC I 28661. — 1 ♂, 4.8; 1 adolescent, 3.6; 5 September 1967; dredge; FSBC I 28662. — 1 ovig. ♀ (with bopyrid), 4.1; 12 October 1967; trawl; FSBC I 23876. — 1 ♂, 4.9; 1 ovig. ♀, 5.1; 3 juv. (1 with bopyrid), 3.0-3.2; 12 October 1967; trawl; FSBC I 28663. — 1 ♂, 4.1; 1 ovig. ♀, 4.2; 12 October 1967; dredge; FSBC I 28664. — 4 ♂, 4.3-5.1; 7 ovig. ♀, 4.1-6.1; 1 ovig. adolescent, 3.4; 2 juv., 2.5, 2.8; 15 November 1967; dredge; FSBC I 28665. -- FMG STATION 151: 1 ♂, 4.1; 1 ovig. ♀, 4.3; 27-30 m; 3 October 1978; *Madracis decactis*; MESC 6179-2194. — 1 juv., 2.1; 28 m; 5 October 1978; *Madracis decactis*; MESC 6179-2195. — 2 ♂, 3.8, 5.0; 2 ovig. ♀, 4.7, 4.7; 26-27 m; 5 October 1978; *Madracis decactis*; MESC 6179-2196. — 1 ♂, 5.1; 1 ovig. ♀, 5.0; 2 juv., 3.1, 3.2; 26-27 m; 5 October 1978; *Agelas dispar*; MESC 6179-2197. — 2 juv., 1.8, 2.8; 26-27 m; 5 October 1978; *Agelas dispar*; MESC 6179-2198. — 1 juv., 3.2; 26-27 m; 5 October 1978; *Agelas dispar*; MESC 6179-2199. — 1 ♂, 5.1; 1 ovig. ♀, 5.9; 27 m; 19 October 1978; MESC 6179-2200. — 1 ♂, 4.6; 1 ovig. ♀, 4.6; 26-27 m; 17 January 1979; *Agelas dispar*; MESC 6179-2201. — 1 juv., 2.5; 26-27 m; 17 January 1979; *Agelas dispar*; MESC 6179-2202. —1 ♂, 5.2; 1 ovig. ♀, 5.8; 1 juv., 2.8; 26-27 m; 17 January 1979; *Agelas dispar*; MESC 6179-2203. —1 ♂, 4.3; 1 ovig. ♀, 4.7; 26-27 m; 17 January 1979; *Agelas dispar*; MESC 6179-2204. — 1 juv., 2.9; 26-27 m; 17 January 1979; *Agelas dispar*; MESC 6179-2205. — 1 ovig. ♀, 5.9; 1 juv., 3.3; 27 m; 18 January 1979; *Agelas dispar*; MESC 6179-2206. — 1 juv., 3.1; 32 m; 28 June 1979; *Agelas dispar*; MESC 6179-2207. — 1 juv., 2.2; 32 m; 28 June 1979; *Agelas dispar*; MESC 6179-2208. — 2 ♂, 4.0, 4.9; 1 ovig. ♀, 4.9; 2 juv., 2.3, 2.5; 32 m; 28 June 1979; *Agelas dispar*; MESC 6179-2209. — 1 ♂, 4.3; 1 ovig. adolescent, 3.7; 32 m; 28 June 1979; *Agelas dispar*; MESC 6179-2210. — 1 ♂, 5.3; 1 ovig. ♀, 5.5; 29 m; 28 June 1979; *Madracis decactis*; USNM 189167. — 3 ♂, 3.6-6.0; 3 ovig. ♀, 4.8-6.1; 3 juv., 2.0-3.3; 29 m; 28 June 1979; *Madracis decactis*; MESC 6179-2211. — 1 juv., 2.1; 29 m; 28 June 1979; *Madracis decactis*; MESC 6179-2212. — 1 ♂, 5.2; 26 m; 10 July 1979; MESC 6179-2213. — FMG STATION 247: 1 ♂, 4.8; 1 ovig. ♀, 4.9; 1 juv., 2.5; 30 m; 11 October 1978; MESC 6179-2214. — 2 ♂, 3.9, 4.3; 27 m; 11 October 1978; *Agelas dispar*; MESC 6179-2215. — 1 ♂, 5.3; 1 ovig. ♀, 4.6; 29-30 m; 12 October 1978; *Agelas dispar*; USNM 189166. — 3 ♂, 3.8-4.5; 3 ovig. ♀, 4.1-4.8; 1 juv., 3.2; 27-30 m; 12 October 1978; *Agelas dispar*; MESC 6179-2216. — 1 juv., 3.0; 27-30 m; 12 October 1978; *Agelas dispar*; MESC 6179-2217. — 2 ♂, 4.6, 5.1; 1 ovig. ♀, 4.8; 5 juv., 2.0-2.8; 30 m; 13 October 1978; *Madracis decactis*; MESC 6179-2218. — 1 juv., 2.3; 30 m; 13 October 1978; *Madracis decactis*; MESC 6179-2219. — 1 juv., 1.8; 30 m; 13 October 1978; *Madracis decactis*; MESC 6179-2220. — 1 ♂, 4.9; 1 ovig. ♀, 4.8; 30 m; 13 October 1978; *Madracis decactis*; MESC 6179-2221. — 1 juv., 2.6;

26-30 m; 30 January 1979; *Agelas dispar*; MESC 6179-2222. — 1 ♂, 4.4; 1 ovig. ♀, 4.7; 26-30 m; 30 January 1979; *Agelas dispar*; MESC 6179-2223. — 3 ♂, 4.3-5.2; 3 ovig. ♀, 4.7-5.8; 1 juv., 2.3; 29-30 m; 21 June 1979; *Madracis decactis*; MESC 6179-2224. — 1 ♂, 3.8; 29-30 m; 21 June 1979; *Madracis decactis*; MESC 6179-2225. — 1 ♂, 3.9; 1 juv., 2.9; 29 m; 21 June 1979; *Agelas dispar*; MESC 6179-2226. — 2 ♂ (1 with bopyrid), 3.9, 4.0; 1 adolescent, 3.4; 2 juv., 2.3, 2.8; 29 m; 21 June 1979; *Agelas dispar*; MESC 6179-2227. — 4 juv., 2.1-3.3; 29 m; 21 June 1979; *Agelas dispar*; MESC 6179-2228. — 4 ♂, 4.1-4.4; 1 ovig. ♀, 4.4; 2 adolescents (1 ovig., 3.0), 3.3; 2 juv., 2.1, 2.9; 27-29 m; 21 June 1979; *Agelas dispar*; MESC 6179-2229. — 1 ovig. ♀, 4.7; 34 m; 25 June 1979; MESC 6179-2230. —FMG STATION 481: 1 juv., 2.8; 27-29 m; 6 October 1978; *Agelas dispar*; MESC 6179-2231. — 1 ♂, 5.0; 1 ovig. ♀, 5.2; 1 juv., 2.2; 27-29 m; 6 October 1978; *Madracis decactis*; MESC 6179-2232. — 1 juv., 3.3; 27-30 m; 7 October 1978; *Agelas dispar*; MESC 6179-2233. — 1 ovig. ♀, 5.8; 27-30 m; 7 October 1978; *Agelas dispar*; MESC 6179-2234. — 1 ♂, 4.9; 1 ovig. ♀, 6.3; 1 juv., 2.3; 29 m; 8 October 1978; *Agelas dispar*; MESC 6179-2235. — 1 juv., 2.4; 30-34 m; 8 July 1979; *Agelas dispar*; MESC 6179-2236. — 1 juv., 3.3; 30-34 m; 8 July 1979; *Agelas dispar*; MESC 6179-2237. — 1 juv., 2.3; 30-34 m; 8 July 1979; *Agelas dispar*; MESC 6179-2238. — 1 juv., 2.1; 32 m; 8 July 1979; *Madracis decactis*; MESC 6179-2239. — 3 ♂, 3.8-4.9; 3 ovig. ♀, 3.8-5.3; 27-30 m; 8 July 1979; *Madracis decactis*; MESC 6179-2240. — FMG STATION 491: 1 ♂, 4.5; 1 ovig. ♀, 4.8; 1 juv., 3.3; 30 m; 14 October 1978; *Madracis decactis*; MESC 6179-2241. — 1 ♂, 5.8; 1 ovig. ♀, 5.8; 29 m; 16 October 1978; *Agelas dispar*; MESC 6179-2242. — 1 juv., 3.1; 29 m; 16 October 1978; *Agelas dispar*; MESC 6179-2243. — 1 juv., 2.5; 29 m; 16 October 1978; *Agelas dispar*; MESC 6179-2244. — 1 juv., 2.8; 29 m; 17 October 1978; *Agelas dispar*; MESC 6179-2245. — 2 juv., 1.8, 2.5; 30 m; 4 July 1979; *Agelas dispar*; MESC 6179-2246. — 5 juv., 1.7-3.3; 30 m; 4 July 1979; *Agelas dispar*; MESC 6179-2247. — 1 juv., 2.3; 30 m; 4 July 1979; *Agelas dispar*; MESC 6179-2248. — 1 juv., 2.3; 32 m; 4 July 1979; *Madracis decactis*; MESC 6179-2249. — 1 ♂, 4.4; 1 ovig. ♀, 4.8; 1 juv., 2.8; 26-30 m; 4 July 1979; *Madracis decactis*; MESC 6179-2250. — FMG STATION 492: 1 ♂, 5.2; 1 ovig. ♀, 5.1; 29 m; 5 July 1979; *Ircinia strobilina*; MESC 6179-2251. — 6 ♂, 3.9-5.2; 6 ovig. ♀, 4.3-6.2; 13 juv., 1.6-3.2; 27-34 m; 5 July 1979; *Madracis decactis*; MESC 6179-2252. — 1 ♂ (with bopyrid), 4.3; 1 ovig. ♀, 4.4; 34 m; 6 July 1979; MESC 6179-2253. — OTHER MATERIAL: 1 juv.; Bright Bank; 27°53'N, 93°18'W; 55-94 m; 21 September 1977; submersible; TAMU 2-6247. — 2 ♂, 3.4, 4.5; 1 ovig. ♀, 4.3; 1 ♀, 5.3; 1 juv., 2.4; off St. Thomas, Virgin Islands; 36-42 m; 6 February 1899; *Fish Hawk* Station 6079; SYNTYPES of *S. pandionis*; USNM 38400. — 1 ♀, 4.6; off St. Thomas, Virgin Islands; 36-42 m; 6 February 1899; *Fish Hawk* Station 6079; HOLOTYPE of *S. pandionis extentus*; USNM 38401. — 1 ♂, 5.8; 1 ovig. ♀, 3.3; 1 ♀, 5.8; off Sanibel Island; 26°33'N, 83°10'W; 51 m; 2 April 1901; *Fish Hawk* Station 7123; SYNTYPES of *S. grampusi*; USNM 38399.

Diagnosis: Rostrum (Figures 40b, 43b) slender, subequal to or exceeding bluntly rounded ocular hoods; ventral rostral process produced, juxtaposed with ocular bossae. Pleuron of first abdominal somite of male (Figure 43c) bearing strong, hooked tooth posteriorly; those of second and third somites variable (Figure 43c, f, g), ranging from broadly rounded to acuminate posteroventrally; those of fourth, fifth, and sixth acuminate. Telson (Figures 40d, 43a) broad anteriorly, narrow posteriorly, lateral margins distinctly concave in posterior 1/4; dorsal surface with 2 pairs of strong spines, posterior pair arising just proximal to midlength of segment, anterior pair situated about midway between posterior pair and anterior margin. Stylocerite (Figures 40b, 43b) extending to distal 1/4 of first segment of antennular peduncle. Scaphocerite subequal to lateral spine of basicerite, development of blade of scaphocerite variable, often absent; basicerite not angulate dorsally. Palm of major chela (Figure 41a-c) terminating distodorsally in blunt tubercle, secondarily armed with slender spine usually directed distoventrally. Dactyl of minor chela (Figure 42a, b) bidentate distally, tips arranged in plane of finger, dense fringe of curved hairs on extensor surface; fixed finger usually simple; length of carpus about 1/2 that of chela. Carpus of

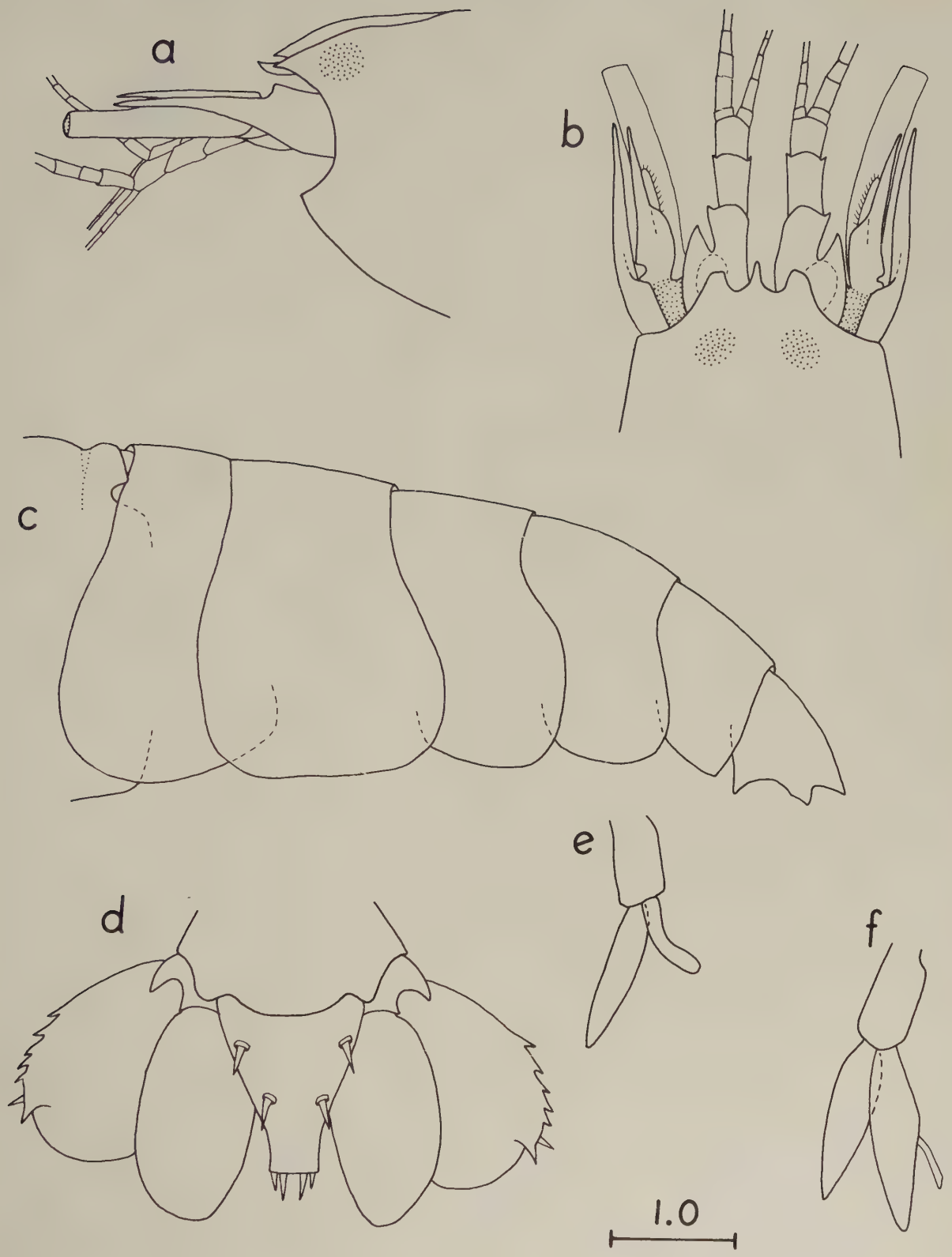

Figure 40. *Synalpheus pandionis*, ovigerous female, CL 4.6, USNM 189166; a. anterior region, lateral view; b. same, dorsal view; c. abdomen; d. telson and uropods; e. left pleopod 1; f. left pleopod 2.

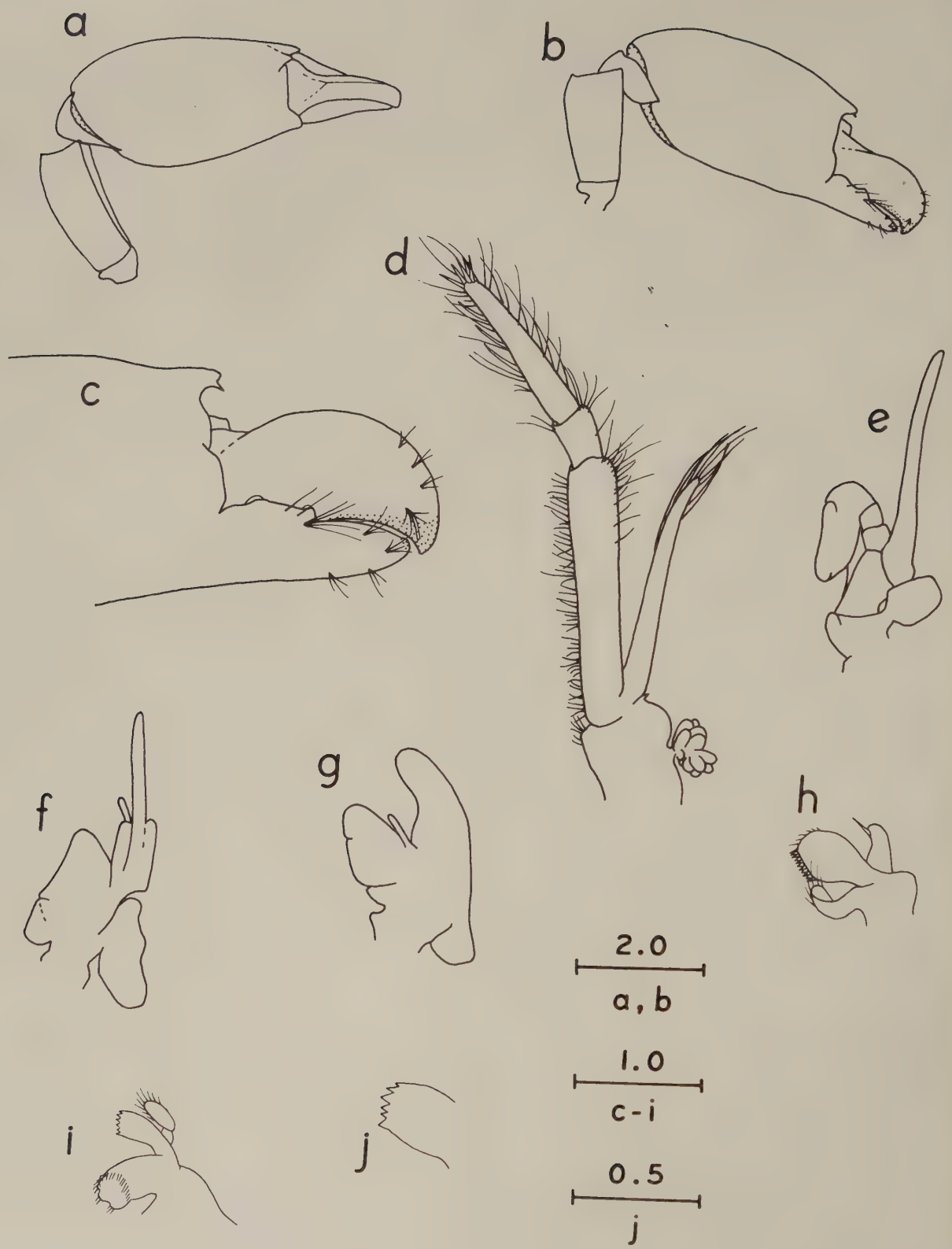

Figure 41. *Synalpheus pandionis*, ovigerous female, CL 4.6, USNM 189166; a. right major chela, dorsal view; b. same, lateral view; c. same, lateral view of distal region; d. left maxilliped 3; e. left maxilliped 2; f. left maxilliped 1; g. left maxilla 2; h. left maxilla 1; i. left mandible; j. same, incisor process.

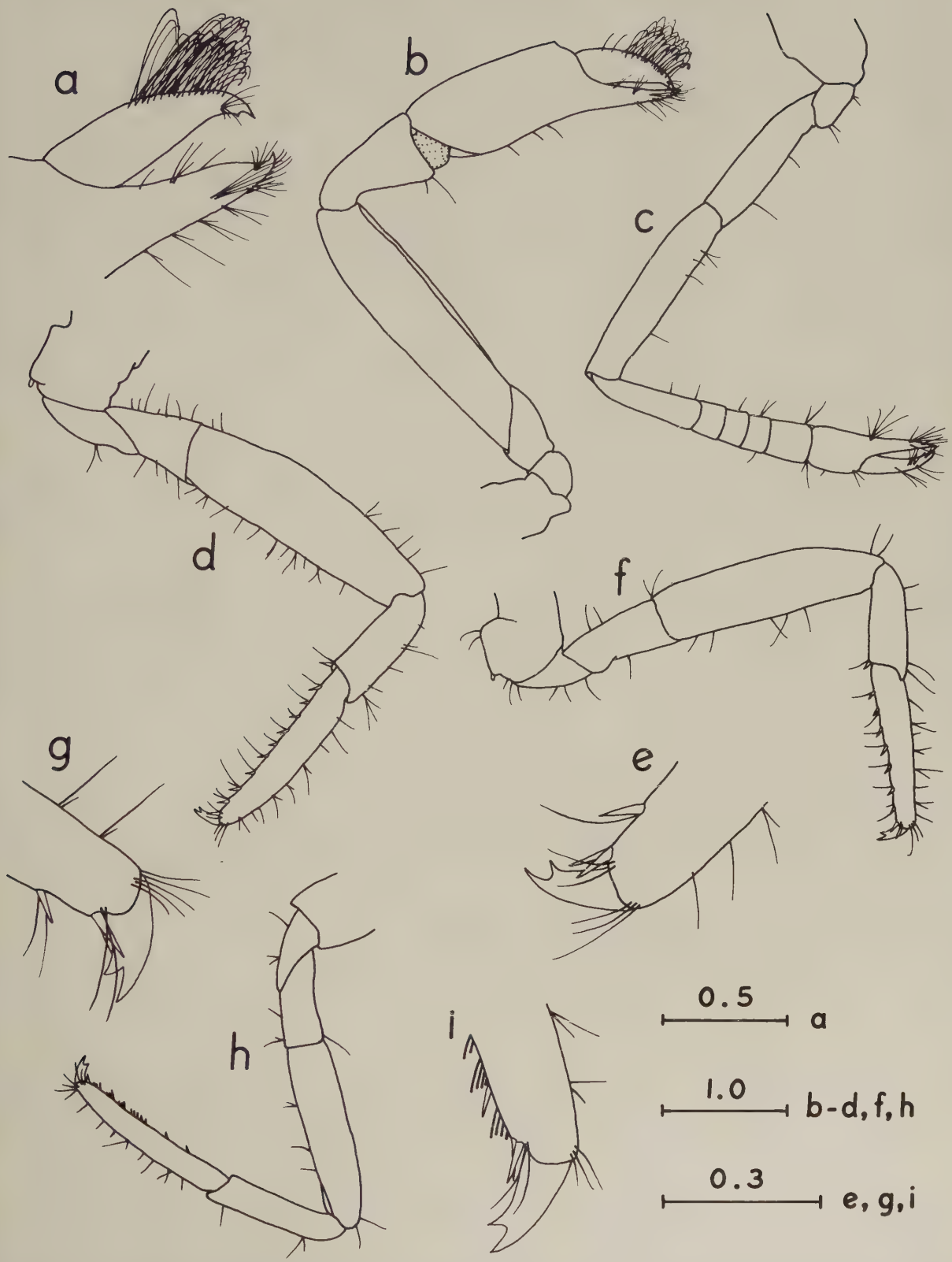

Figure 42. *Synalpheus pandionis*, ovigerous female, CL 4.6, USNM 189166; a. left minor chela, mesial view of distal region; b. same, whole appendage; c. left pereopod 2; d. left pereopod 3; e. same, dactyl; f. left pereopod 4; g. same, dactyl; h. left pereopod 5; i. same, dactyl.

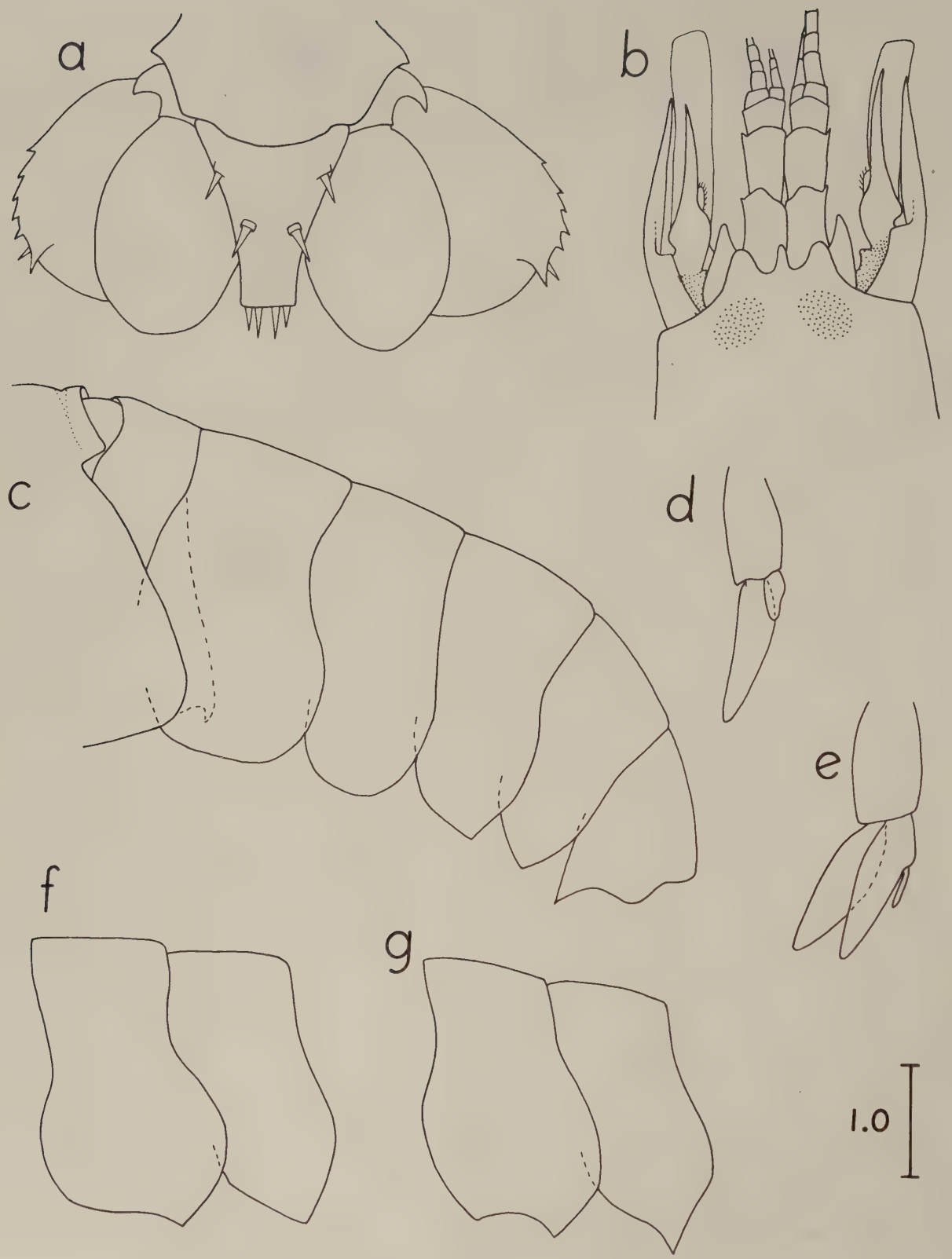

Figure 43. *Synalpheus pandionis*, male from Florida Middle Ground, CL 5.3, USNM 189166; a. telson and uropods; b. anterior region, dorsal view; c. abdomen; d. left pleopod 1; e. left pleopod 2. Male from Florida Middle Ground, CL 5.3, USNM 189167; f. abdominal pleura 2 and 3. Male from Hourglass Station C, CL 5.3, USNM 189164; g. abdominal pleura 2 and 3.

TABLE 8. COMPARISON OF SIMILAR *Synalpheus* SPECIES WITH SERRATE UROPODS.

	S. goodei	*S. longicarpus*	*S. pandionis*
Length of basicerite relative to scaphocerite	less than	less than	subequal
Basicerite armed dorsally	yes	no	no
Carpus/chela ratio of minor pereopod 1 — mean (range)	0.45 (0.38-0.50)	0.60 (0.47-0.68)	0.50 (0.37-0.63)
Teeth of dactyl of minor chela	almost tridentate; tips arranged perpendicular to plane of chela	deeply bidentate; tips arranged in plane of chela	bidentate; tips arranged in plane of chela
Uropodal teeth, exclusive of movable and sutural spines	6-10	4-7	4-7
Carapace length of adult females	4.1-7.3	4.7-9.3	3.8-6.7

pereopod 2 (Figure 42c) composed of 5 articles. Dactyls of posterior 3 pereopods (Figure 42e, g, i) with proximal tooth weaker than and slightly divergent from distal tooth. Lateral branch of uropods (Figures 40d, 43a) usually with 4-7 fixed teeth proximal to movable spine.

Variation: As Chace (1972) noted, the antennal blade varies in development from complete absence to a thin but well-developed blade extending nearly to the tip of the scaphocerite. My attempts to find other differences between specimens with an antennal blade and those without failed, substantiating the synonymy of *S. grampusi* Coutière, 1909, with *S. pandionis* by Chace (1972).

Two morphometric characters vary in specimens of *S. pandionis*. The carpus of the minor first pereopod is short in juveniles but becomes progressively longer relative to the chela in older specimens. The number of uropodal teeth ranges from 2 to 10, excluding the movable and sutural spines. The extremes of this range, however, are represented by only a few individuals; over 90% of the adults are armed with 4 to 7 teeth.

An occasional specimen has the dorsal process of the basicerite sharply rectangular, approaching *S. goodei* in this respect. These can usually be distinguished from *S. goodei* by the relative lengths of the lateral spines of the basicerite and the scaphocerite and by the dentition of the fingers of the minor chela.

Although Christoffersen (1979) considered *S. pandionis* synonymous with *S. longicarpus*, he correctly noted that the secondary spine of the distodorsal tubercle of the major chela may be directed either distally or distoventrally and that the fixed finger of the minor chela, usually simple, may be obscurely bidentate.

Variation in the shape of the abdominal pleura seems to be linked to sexual development. In Hourglass material of *S. pandionis*, the degree of acumination of the ventral margin of the second abdominal pleuron is a more sensitive indicator of sex than is that of the first pleuron. Ovigerous adolescent females exhibit a typically male-like, hooked posteroventral margin of the first abdominal pleuron; all ovigerous females, both adult and adolescent, have the second pleuron broadly rounded ventrally. In non-ovigerous adolescents, the degree of acumination of the second

pleuron is variable. It may be that those adolescents with a rounded second pleuron are non-ovigerous females.

Adult males in the Hourglass samples usually have the posteroventral margin of the second abdominal pleuron acute (Figure 43g), but those from the Florida Middle Ground were not as consistent. Many adult males from the Middle Ground had second pleura similar to those of ovigerous females (Figure 43c), and others exhibited varying degrees of acumination (Figure 43f); at least one had the pleuron rounded on one side and acute on the other.

Color: Based on notes taken from live material from the Florida Middle Ground: Carapace, abdomen, telson, and uropods pale straw yellow, with light scattering of red chromatophores on carapace; gastric region brown internally; eggs light green. Antennae, antennules, maxilliped 3, pereopods, and pleopods transparent straw yellow; major and minor pereopods orange-red on distal margins.

Size (CL in mm): Males, 3.8-6.6; ovigerous females, 3.8-6.7; adolescents, 3.0-3.9; juveniles, 1.0-3.3.

Habitat: Taken from a variety of habitats: under stones (Schmitt, 1936); from seagrass meadows (Chace, 1972; Heck, 1977); from the sponges *Agelas dispar* and *Ircinia strobilina* (present study); from dead (Pequegnat and Ray, 1974; Gore, 1981) and living [*Madracis decactis* (present study)] coral. Hourglass specimens were collected from bottom temperatures ranging from 15.8 to 31.0°C and from bottom salinities ranging from 32.4 to 36.7 °/∞. Ranges of the same parameters for Florida Middle Ground specimens were 17.1 to 26.0°C and 34.6 to 36.2°/∞.

Distribution: Atlantic: off central eastern Florida and the Florida Keys (Gore, 1981) and probably Brazil (Christoffersen, 1979); Gulf of Mexico: Florida Middle Ground south to the Dry Tortugas (Coutière, 1909; Zimmer, 1913; Chace, 1956b; present study) in the eastern Gulf, West Flower Garden Bank (Pequegnat and Ray, 1974) and Isla de Lobos Reef, off Veracruz (Ray, 1974) in the western Gulf; Caribbean: Puerto Rico (Schmitt, 1935), Virgin Islands (Coutière, 1909; Chace, 1972), Barbados (Schmitt, 1924b), Curaçao (Schmitt, 1924a), off Panama (Heck, 1977), and Venezuela (Chace, 1956a). Distributed bathymetrically from less than 1m (Chace, 1972) to 73 m and possibly 94 m (Pequegnat and Ray, 1974).

Remarks: Five of the specimens from the Virgin Islands (*Fish Hawk* Station 6079), reported as *Synalpheus laevimanus parfaiti* by Rathbun (1901), were designated the syntypic series of *S. pandionis* by Coutière (1909). Another specimen from that station became the holotype of *S. pandionis extentus* Coutière, 1909.

Chace (1972) noted that, contrary to the description and figures by Coutière (1909), the types of *S. grampusi* possess distinct antennal blades similar to those of *S. pandionis*. Accordingly, he considered the two species to be identical but selected the name *S. pandionis* despite the position precedence of *S. grampusi*. At the same time, he confirmed the distinctness of *S. parfaiti*.

Synalpheus pandionis extentus is yet another of Coutière's subspecies which exemplifies a common variation and is sympatric with the typical form.

Christoffersen (1979) considered *S. pandionis* to be a junior synonym of *S. longicarpus* and pointed out the similarity of *S. goodei* to his material. Gulf of Mexico populations of these three species, although similar, may be readily separated using the characters presented in Table 8.

TABLE 9. MONTHLY CATCH OF *Synalpheus pandionis* AT HOURGLASS STATIONS.

Synalpheus pandionis																														
STA	1965					1966													1967											TOT
	A	S	O	N	D	J	F	M	A	M	J	J	J sp	A	S	O	N	D	J	J sp	F	M	A	M	J	J	A	S	O	N	
A																															
B_1										1	4				1			5				3	1	7	3				1		26
B_2												6		7	8	1		5					3	7	1		2				40
C_1										1								10	4	1	5		2					1			24
C_2							1	1	2								1		1					1				4		2	13
D_1						2											2						4					1	2		11
D_2				3								3					1	2	1			1		1	2			2			16
E												1								2							2				5
I														2														3			5
J									1	2	2		1	2						12		5								3	28
K												1									3	1	1					1			7
L	2	2	2	1		1	1	5	5	3	1	8		20	40	13	33	34	39	3	40		14	10	8	10	12	7	15	5	334
M						2	7		2	2	13	2	1	5	15	2	4	4	2		7	16	11	12	3	20	11	7	8	14	170
TOT	2	2	2	4		5	9	6	10	9	20	21	2	36	64	16	41	60	47	18	55	26	36	38	17	30	27	26	26	24	679

Subscripts 1, 2, and SP represent regular (night), post (day), and supplementary (45 ft trawl) cruises.

Pending a comparison of characteristics which seem stable in Gulf specimens but vary in Brazilian material, the species are best considered distinct.

Abundance, seasonality, and size structure of the population: Occurrence of *Synalpheus pandionis* in Hourglass collections made from December 1965 through November 1967 was analyzed for bathymetric distribution, reproductive patterns, and seasonal size structure. *Synalpheus pandionis* was collected more consistently than any other Gambarelloides *Synalpheus* (Table 9).

Like *S. goodei*, *S. pandionis* was most abundant on the southern transect of the Hourglass cruise track. Depth distribution also differed between the two transects. *Synalpheus pandionis* was most abundant at the 18 and 37 m stations on the northern transect and at 55 and 73 m stations on the southern transect (Figure 44). The dissimilar modal occurrences probably result from microhabitat similarities between Stations B and C and Stations L and M. Except for a single specimen of *S. herricki*, *S. pandionis* was the only Gambarelloides *Synalpheus* taken from either of the 6 m Hourglass stations.

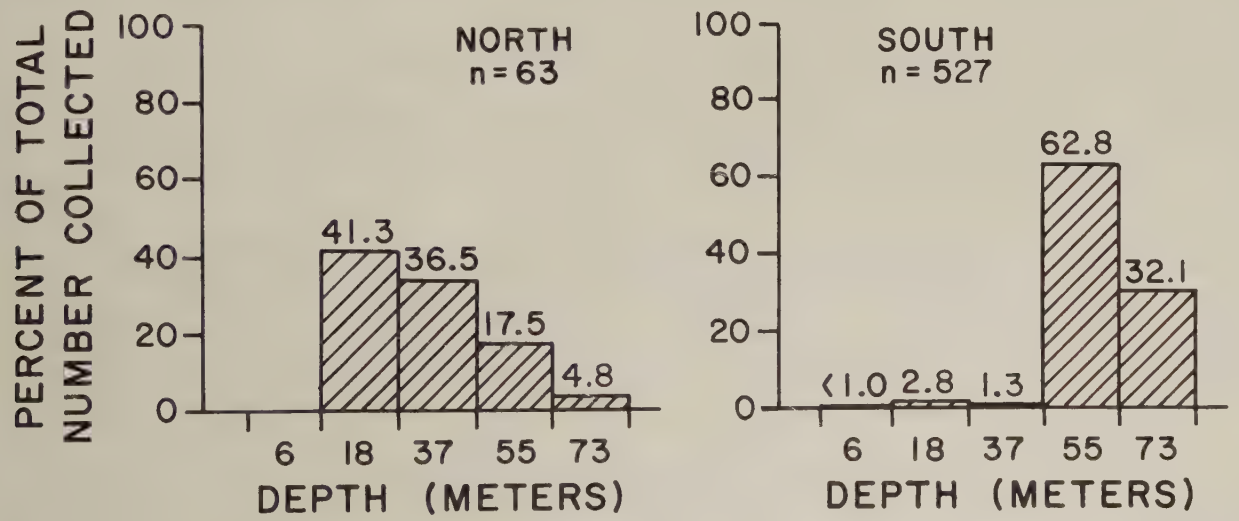

Figure 44. Relative abundance of *Synalpheus pandionis* by depth at Hourglass stations on north and south transects during regular (night) sampling. Dredge and trawl samples combined; 45-ft trawl catches omitted.

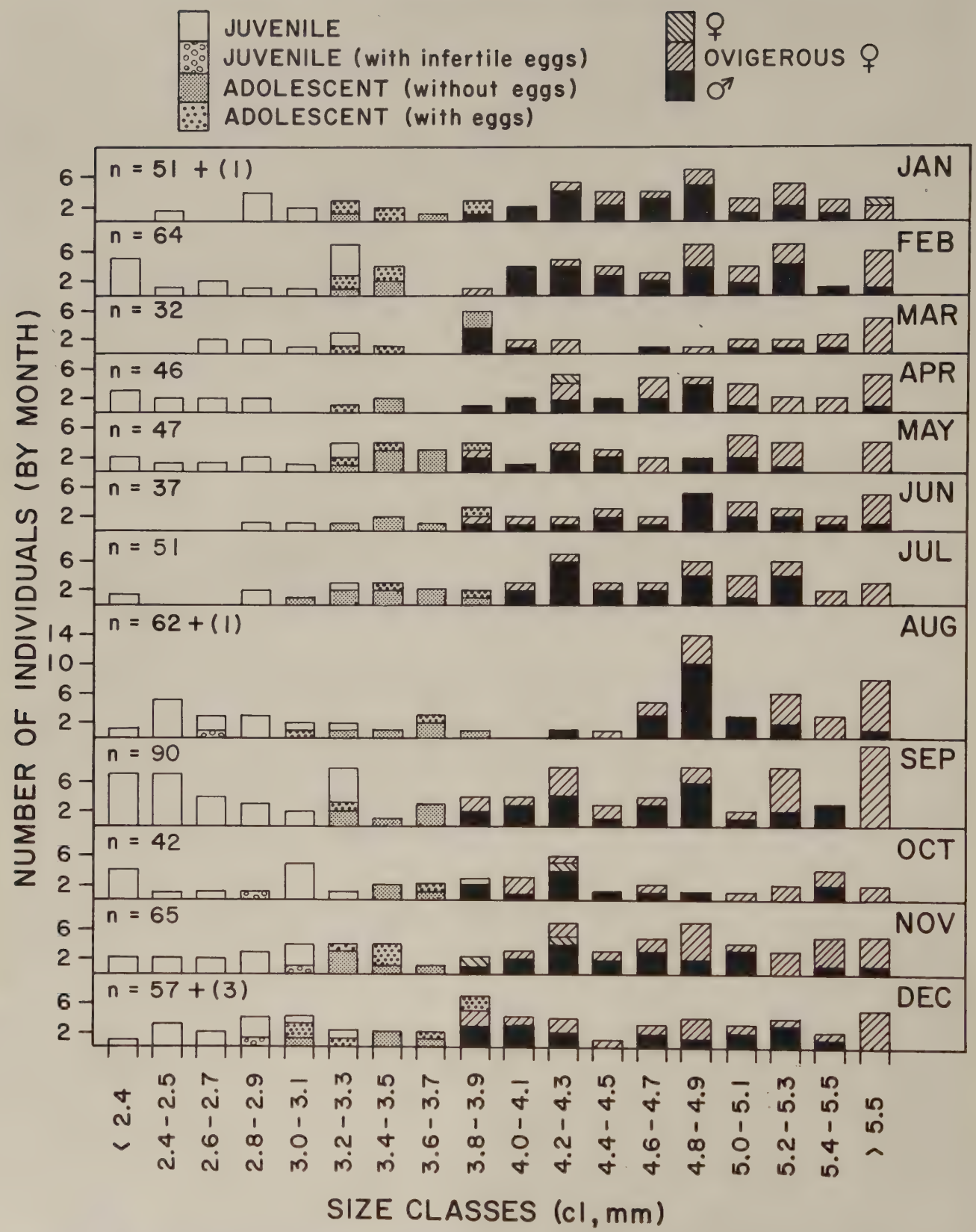

Figure 45. Size structure of population of *Synalpheus pandionis* at Hourglass stations. Monthly catches from December 1965 through November 1967 combined. Numbers in parentheses represent damaged, unmeasurable specimens.

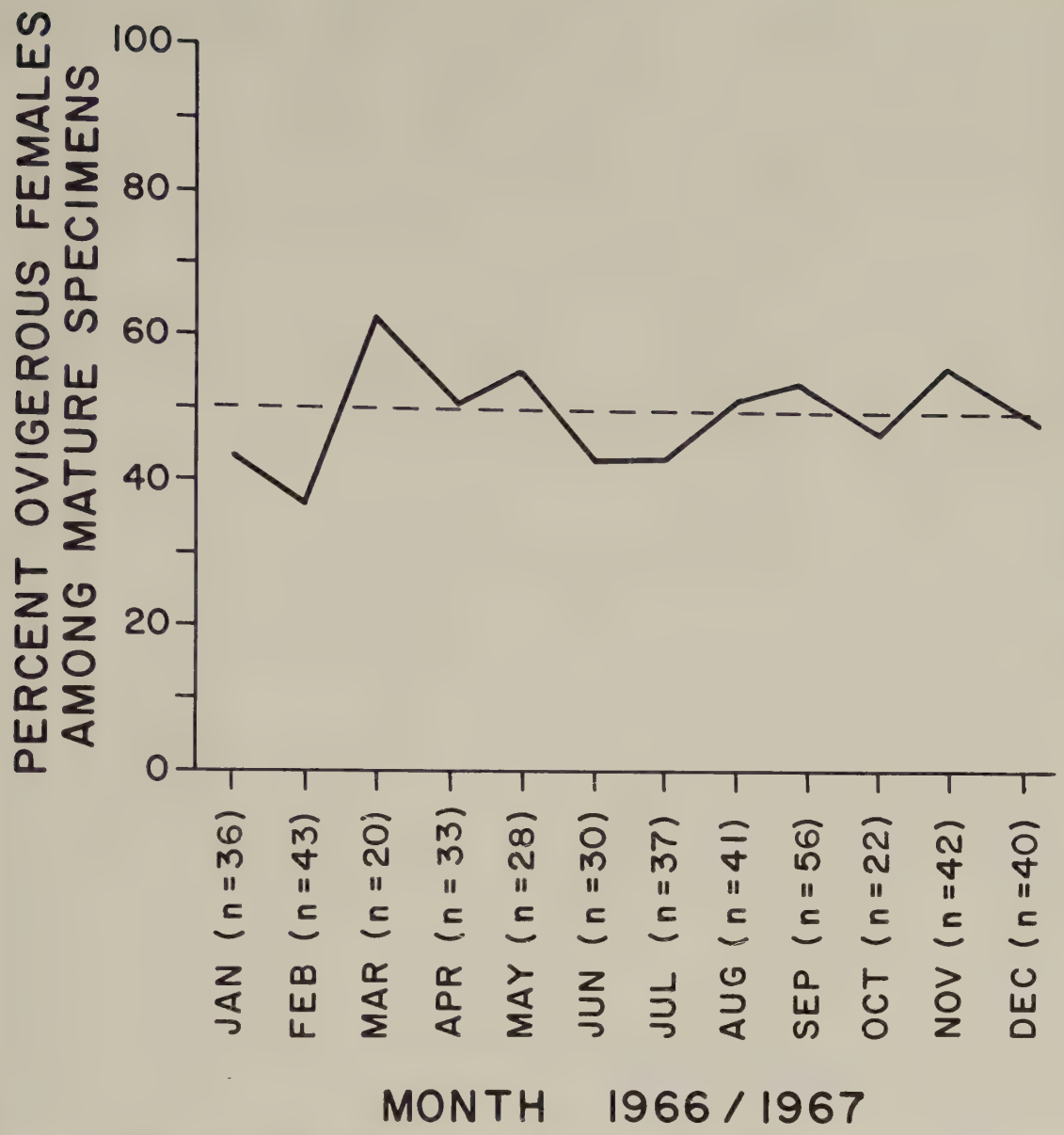

Figure 46. Percent normal ovigerous specimens among adult *Synalpheus pandionis* collected at Hourglass stations. Monthly catches from December 1965 through November 1967 combined.

Seasonal influence on abundance and reproduction seems to be negligible. Recruitment, as evidenced by the presence of juveniles, was continuous (Figure 45). Ovigerous females were taken during every month from February 1966 to November 1967. Females larger than 3.9 mm CL were nearly always ovigerous and were about as abundant as males (Figure 46). Year-round breeding obscured modal progressions in size (Figure 45).

Three distinct size classes of *S. pandionis* bear eggs: (1) adult ovigerous females (3.8-6.7 mm CL) with abdominal pleura similar to those in Figure 40c and with normal eggs; (2) adolescent females (3.0-3.9 mm CL) which carry fertile eggs but have the first abdominal pleuron hooked ventrally as in adult males; and (3) juveniles (2.7-3.1 mm CL), presumably females, with male pleura similar to those of the adolescents but carrying infertile eggs. The latter, although not nearly

so abundant, correspond to the subadults of *S. brooksi* which carry only infertile eggs. Coutière (1909) noted that eggs of *S. pandionis* give rise to zoeae.

Although pervasive in the Hourglass population, the adolescent size class was almost entirely lacking in the Middle Ground material, being restricted to a few individuals in the June samples. Since both populations clearly reproduce year-round and are located relatively close together, differences in secondary sexual characteristics and size structure are puzzling, but are perhaps due to unrecognized, disparate, environmental pressures.

Infertile eggs occur in a number of species of *Synalpheus* (Coutière, 1909; Felder, 1982), but precocious development of fertile eggs by young specimens with juvenile characteristics has not previously been recognized. Possible causes of both conditions are presented in a general discussion of reproduction in *Synalpheus* (p. 106).

Synalpheus paraneptunus Coutière, 1909

Figures 47-50

Synalpheus paraneptunus Coutière, 1909, pp. 86-89, fig. 52; Schmitt, 1935, p. 150; Chace, 1972, p. 103.

Synalpheus sp. near *paraneptunus*: Schmitt, 1936, p. 369.

[?]*Synalpheus* sp. (near *S. disparodigitus* Armstrong, 1949): Pequegnat and Ray, 1974, p. 250, fig. 57.

Material examined: HOURGLASS STATION M: 1 ♂, 3.5; 1 ♀ (with infertile eggs), 3.1; 15 February 1966; dredge; FSBC I 28666. — 1 juv., 2.5; 13 January 1967; dredge; FSBC I 29453. — OTHER MATERIAL: 1 ovig. ♀, 4.4; Dry Tortugas, Florida; 13 July 1931; W. L. Schmitt (coll.); USNM 65988. — 1 juv., 2.5; West Flower Garden Bank; 27°52'N, 93°49'W; 25 m; 3 September 1970; rotenone station; TAMU 2-6258. — 1 juv., 2.9; Bahía de la Ascensíon, Yucatan; 0.3-2 m; 10 April 1960; Smithsonian-Bredin Station 52-60; USNM 136275. — 1 ovig. ♀, 4.2; 1 ♀, 3.3; 3 juv., 2.2-2.9; Bahía de la Ascensíon, Yucatan; 1-2 m; 14 April 1960; Smithsonian-Bredin Station 72-60; USNM 136276. — 1 ♂, 3.0; 1 ovig. ♀, 3.1; Bahía del Espirítu Santo, Yucatan; 3 m; 6 April 1960; Smithsonian-Bredin Station 41-60; USNM 136274. — 1 ♂, 3.2; 1 juv., 2.6; off Puerto Rico; 18°31'N, 66°10'W; 69 m; 3 February 1933; Johnson-Smithsonian Deep-Sea Expedition Station 16; tangles; USNM 184330. — 1 ♂, 3.6; 1 ovig. ♀, 4.0; Jamaica; 1884; *Albatross*; USNM 41722. — 1 ovig. ♀, 4.5; Guadeloupe; 31 March 1956; Smithsonian-Bredin Station 70-56; USNM 136273. — 1 ♂, 3.7; Dominica; 2-4 m; 26 March 1956; Smithsonian-Bredin Station 55-56; USNM 136270. — 1 ovig. ♀, 5.3; 3 juv., 2.4-3.0; Dominica; 11-27 m; 28 March 1956; Smithsonian-Bredin Station 61-56; dredge; USNM 136271. — 98 ♂, 3.0-4.0; 2 ovig. ♀, 4.0, 4.8; 39 juv., 1.8-2.9; Dominica; 1.5 m; 28 March 1956; Smithsonian-Bredin Station 62-56; USNM 136272. — 1 ovig. ♀, 3.8; Carriacou; 16 March 1956; Smithsonian-Bredin Station 16-56; USNM 136269. — 1 ♂, 4.2; off Golfo de Morrosquillo, Colombia; 09°30'N, 76°20'W; 77 m; 23 March 1884; *Albatross* Station 2142; small beam trawl; HOLOTYPE; USNM 7770.

Diagnosis: Rostrum (Figures 48h, 50g) slender, subequal in length to narrowly tapering ocular hoods, slightly convex ventrally. Pleuron of first abdominal somite of male (Figure 47a) with posteroventral hook indefinite, if present, those of second and third rounded, those of fourth and fifth subrectangular, that of sixth acuminate. Telson (Figures 48g, 50f) narrower posteriorly than anteriorly, lateral margins straight or concave; anterior pair of dorsal spines situated at about 1/3 length of segment, posterior pair arising at midlength. Stylocerite (Figures 48h, 50g) reaching

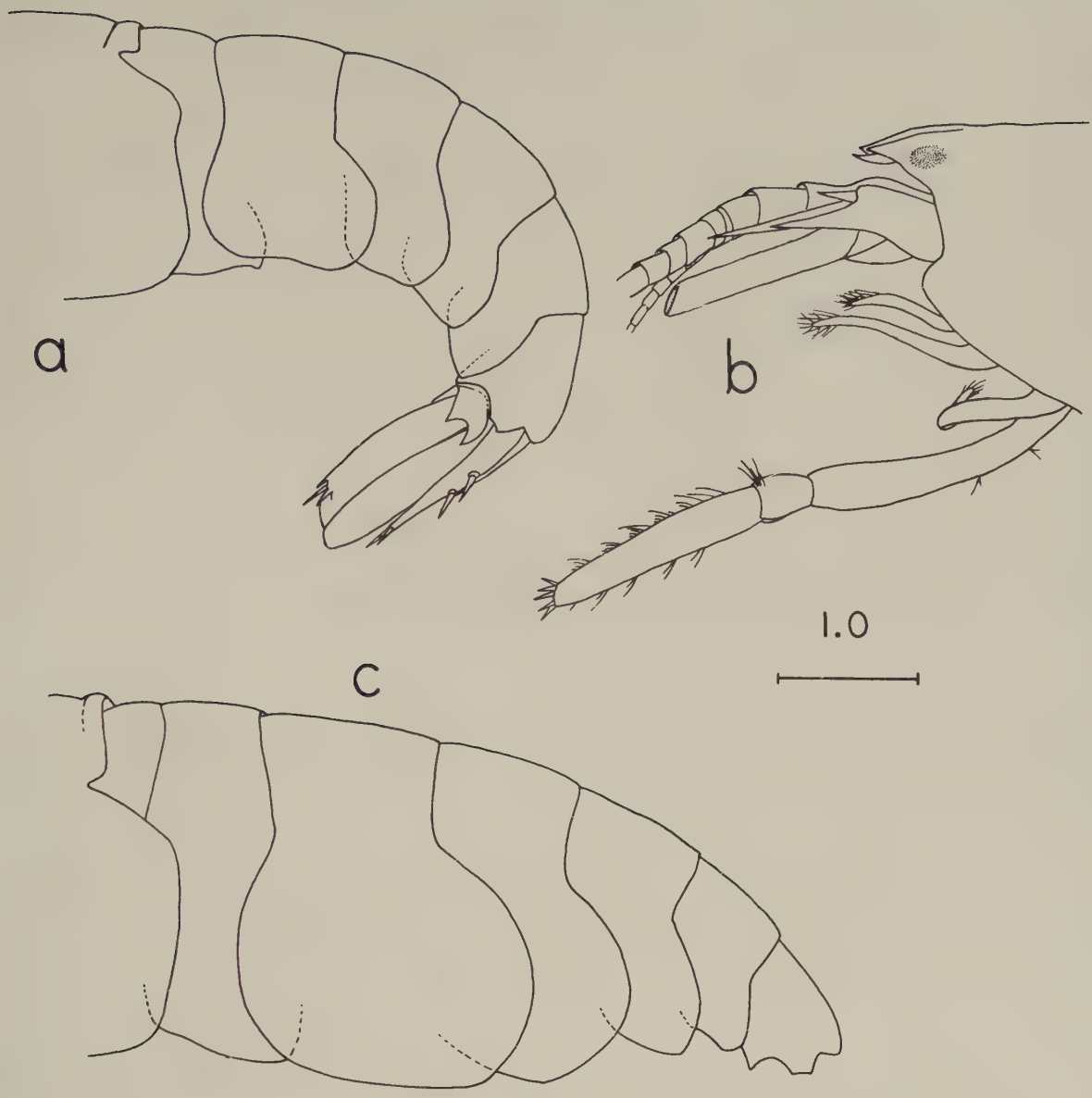

Figure 47. *Synalpheus paraneptunus*, male, CL 3.9, USNM 136272; a. abdomen; b. anterior region, lateral view. Ovigerous female, CL 4.2, USNM 136276; c. abdomen.

nearly to, or slightly beyond, distal margin of first segment of antennular peduncle. Blade usually present on scaphocerite, development variable; spine considerably longer than that of lateral spine of basicerite; basal segment angulate dorsally. Palm of major chela (Figure 48e, f, i) terminating distodorsally in blunt tubercle, armed secondarily with slender spine directed distoventrally. Dactyl of minor chela (Figure 48a-d) with 2 distinct teeth and rectangular cant situated perpendicularly to plane of finger, giving tridentate appearance; fringe of curved hairs on extensor surface considerably reduced; fixed finger also with rectangular projection mesial and slightly posterior to well-defined distal tooth; opposing surfaces excavate; length of carpus not quite 1/2 that of chela. Carpus of pereopod 2 (Figure 49h) composed of 5 articles. Dactyls of posterior 3 pereopods (Figure 50a-c) with proximal tooth stronger than and divergent from distal tooth.

Lateral branch of uropod (Figures 48g, 50f) with 1 to 4, usually 2, fixed teeth proximal to movable spine.

Variation: The rostrum and ocular hoods vary more in this species than is usual in *Synalpheus*. Most specimens are similar to that illustrated in Figure 48h, but some have the ocular hoods more equilateral, with the bases broader and the tips sharper (Figure 50g). The blade of the scaphocerite varies in development from rudimentary (Figure 48h) to long and well developed (Figure 50g). Coutière (1909) incorrectly attributed this variability to sexual dimorphism; in my material, the degree of development is independent of sex. The tip of the stylocerite is usually in line with the distal margin of the first antennular segment, sometimes extending beyond or falling slightly short. The number of uropodal teeth, excluding the movable spine and the sutural spine, varies from 1 to 4. Finally, the distinctiveness of the secondary palmar spine of the major chela varies; although usually clearly separated from the blunt tubercle, an occasional specimen has them merged, giving the entire structure an acute appearance.

Color: A note in the vial with the Tortugas specimen collected by Waldo Schmitt gives the color of this individual as "body and chela transparent, translucent white, movable finger hair brown, eggs and ovary chrome yellow" (but see *Remarks* concerning this specimen).

Size (CL in mm): Males, 3.0-4.2; ovigerous females, 3.1-5.3; juveniles, 1.5-2.9.

Habitat: Associated with living, as well as dead and eroded, coral (Chace, 1972); from colonies of *Zoanthus sociatus* (Schmitt, 1936). The Hourglass specimens were collected from bottom temperatures of 19.4 and 21.5°C and from bottom salinities of 33.9 and 36.2°/∞.

Distribution: Possibly from the Gulf of Mexico, off central western Florida, the Dry Tortugas and the West Flower Garden Bank (see *Remarks*); Caribbean: Jamaica (Coutière, 1909); Puerto Rico (Schmitt, 1935); Yucatan Peninsula, Leeward Islands, Windward Islands (Chace, 1972); Bonaire (Schmitt, 1936); and Colombia (Coutière, 1909). Distributed bathymetrically from very shallow water (0.3 m) (Chace, 1972) to a depth of 77 m (Coutière, 1909).

Remarks: This species differs in several respects from other members of the Gambarelloides group. Unlike most Gambarelloides species, the stylocerite clearly exceeds the distal margin of the first antennular segment in some specimens, contrary to Coutière's (1909) description and to Chace's (1972) key. The fingers of the minor chela are also unique among Gambarelloides species. The excavate opposing margins and the broadened, dentate tips recall a small group of species within the Coutièrei group (previously the Biunguiculatus group) discussed by Banner and Banner (1975: 275). These fundamental differences, combined with the marked reduction of the patterned fringe of hair on the extensor margin of the fixed finger of the minor chela, weaken the homogeneity of the Gambarelloides group, a consideration recognized by Coutière (1909: 87).

The five specimens from the Gulf of Mexico (Figure 50j, k) are referred to this species with some hesitation. The minor chela of the Tortugas specimen is identical with typical *S. paraneptunus*, but the stylocerite and the frontal region of the carapace more closely resemble *S. minus*. The three Hourglass specimens approximate *S. paraneptunus* in the form of the uropods and the frontal region of the carapace, but both lack most appendages, including the minor chela, have a relatively long stylocerite, and have the dorsal surface of the basicerite more produced than the typical form. The specimen reported as *Synalpheus* sp. (near *S. disparodigitus*) by Pequegnat and Ray (1974) cannot be identified with certainty. The frontal region and the uropods strongly

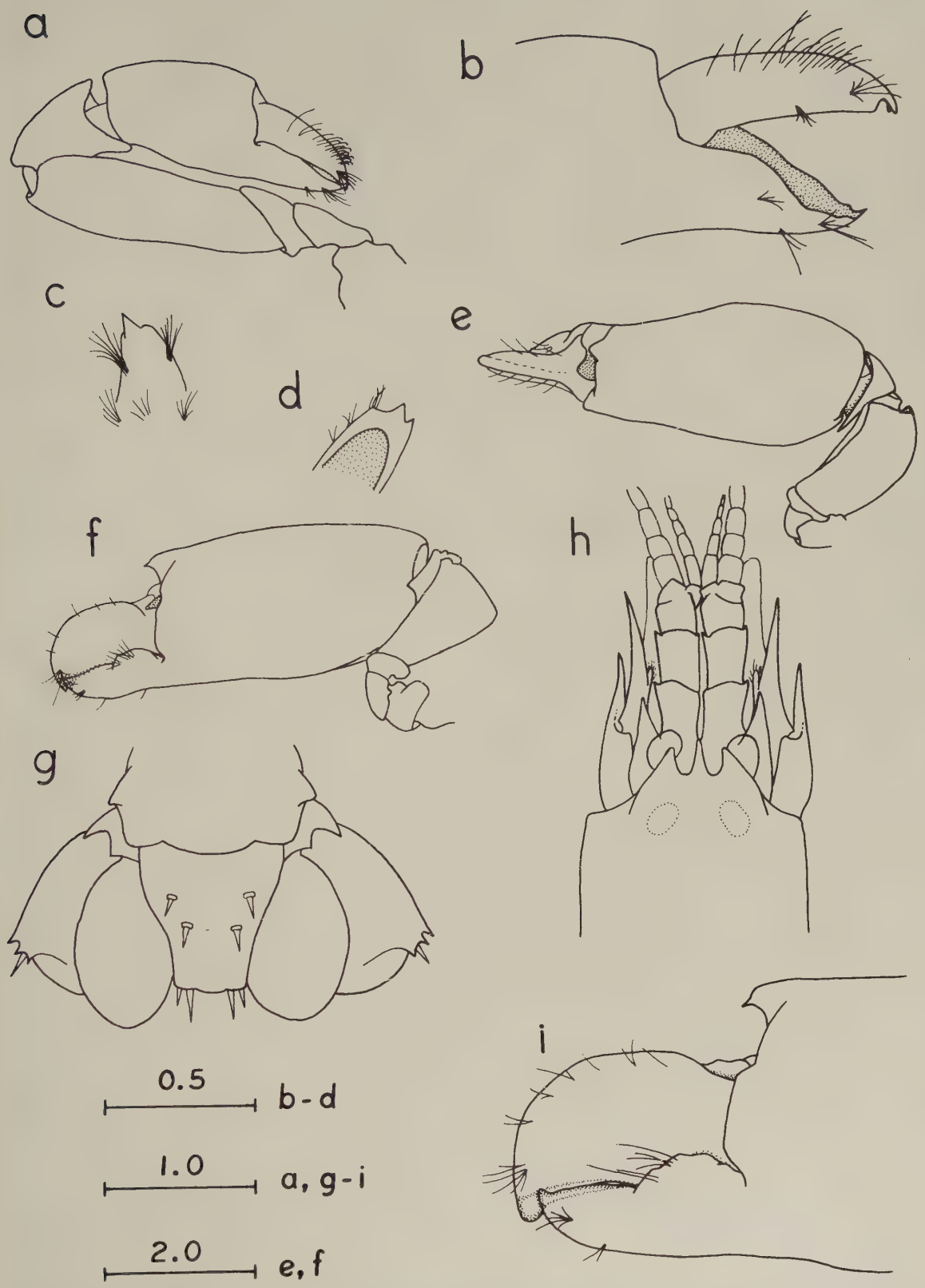

Figure 48. *Synalpheus paraneptunus*, male, CL 3.9, USNM 136272; a. right minor chela; b. same, distal region; c. same, ventral view of fixed finger; d. same, ventral view of dactyl; e. left major chela, dorsal view; f. same, lateral view; g. telson and uropods; h. anterior region, dorsal view; i. left major chela, lateral view of distal portion.

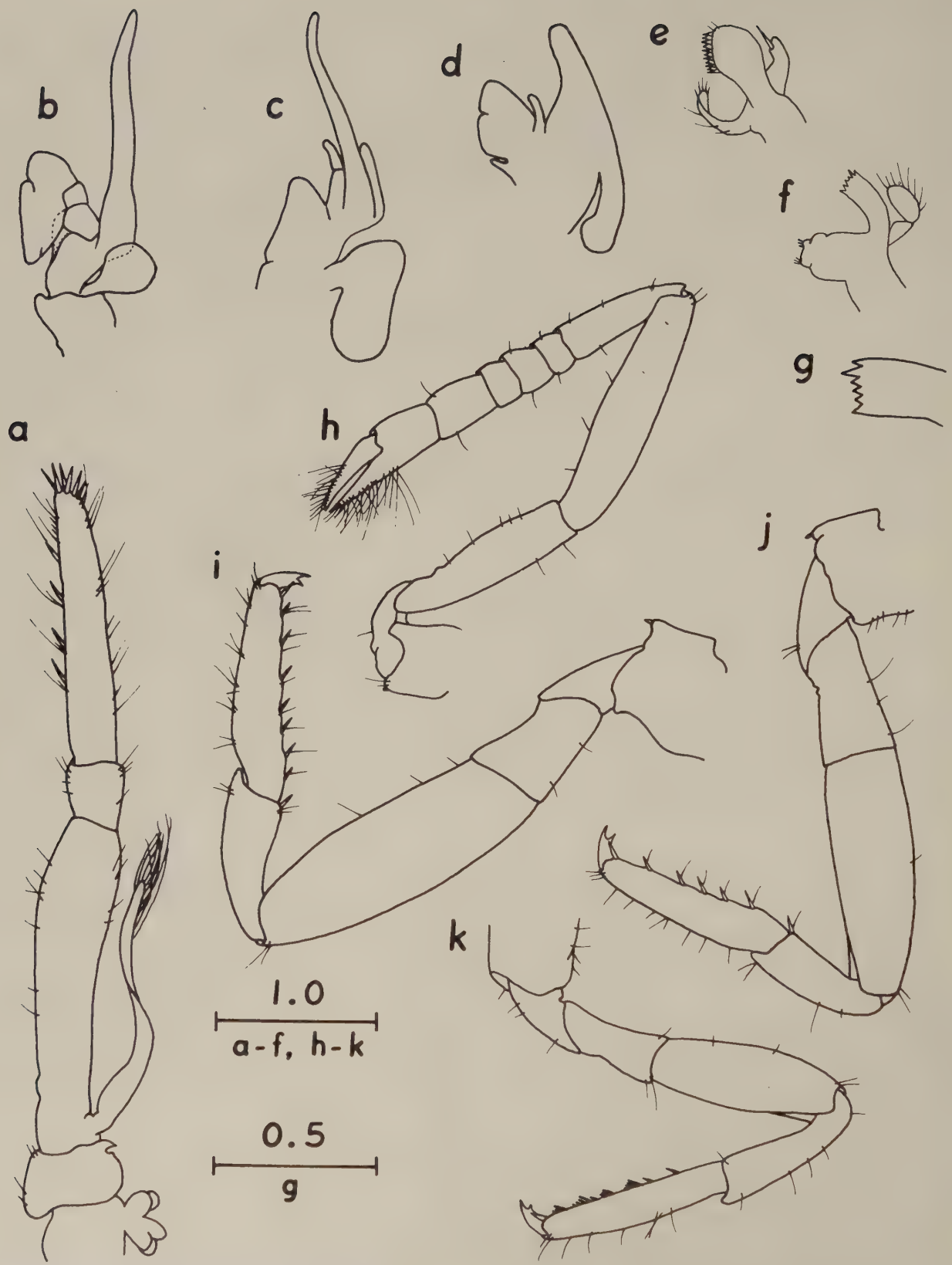

Figure 49. *Synalpheus paraneptunus*, male, CL 3.9, USNM 136272; a. left maxilliped 3; b. left maxilliped 2; c. left maxilliped 1; d. left maxilla 2; e. left maxilla 1; f. left mandible; g. same, incisor process; h. left pereopod 2; i. left pereopod 3; j. left pereopod 4; k. left pereopod 5.

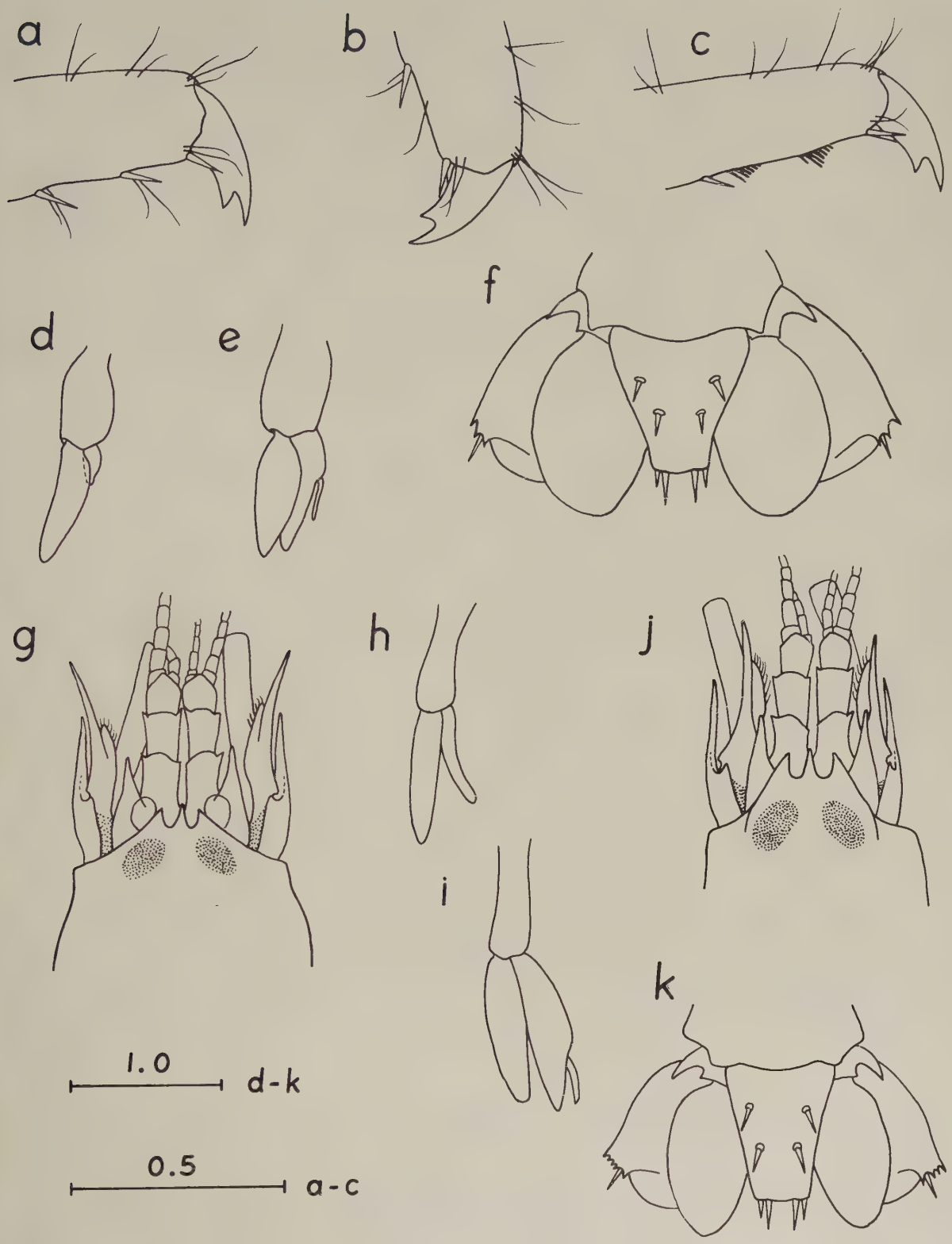

Figure 50. *Synalpheus paraneptunus*, male, CL 3.9, USNM 136272; a. dactyl, left pereopod 3; b. dactyl, left pereopod 4; c. dactyl, left pereopod 5; d. left pleopod 1; e. left pleopod 2. Ovigerous female, CL 4.2, USNM 136276; f. telson and uropods; g. anterior region, dorsal view; h. left pleopod 1; i. left pleopod 2. Male, CL 3.5, FSBC I 28666; j. anterior region, dorsal view; k. telson and uropods.

resemble those of the Hourglass specimens, but the length of the fixed finger of the major chela recalls *S. disparodigitus*. It, too, lacks the crucial minor chela. Therefore, the presence of this species in the Gulf will remain uncertain until additional material is discovered.

Several specimens were mistakenly identified as this species by Chace (1972). One of the ovigerous females from Carriacou (USNM 136269) is actually *S. disparodigitus*. Several juveniles from the Yucatan Peninsula (USNM 136276) cannot be identified with certainty, but do not have the unique minor chela of *S. paraneptunus*. Seven other species of *Synalpheus* were collected from this station (Chace, 1972: 154, 155), and the juveniles undoubtedly belong to one or several of these species.

One of the Hourglass specimens carries several small, infertile eggs. Chace (1972) discussed the possibility of poecilogony in this species but did not mention the occurrence of infertile eggs in Caribbean material.

Synalpheus pectiniger Coutière, 1907

Figures 51-53

Alpheus saulcyi var. *longicarpus* Herrick, 1891, pp. 381-384, pl. 22, fig. [?]14, pl. 24, [?]figs. 2, 4-9 [in part]; Arndt, 1933, p. 249 [in part]. [Not *Alpheus saulcyi* Guérin-Méneville, 1856].

Synalpheus laevimanus var. *longicarpus*: Coutière, 1898, pp. 188-191, fig. 2', 2b'' [? in part]; 1899, pp. 314, 436, 464, 466, figs. 394, 407 [? in part]. [Not *Alpheus laevimanus* Heller, 1862, =*Synalpheus gambarelloides* (Nardo, 1847)].

Synalpheus laevimanus var. *longicarpus* β: Coutière, 1899, pp. 315, 420, 446-449, 466 [? in part]. [Not *Alpheus laevimanus* Heller, 1862, =*Synalpheus gambarelloides* (Nardo, 1847)].

Synalpheus longicarpus β: Coutière, 1899, pp. 454, 468 [? in part]; 1909, p. 3 [in part].

Synalpheus pectiniger Coutière, 1907, p. 611; 1909, pp. 78-82, figs. 48, 49; Schmitt, 1935, p. 151; Pearse, 1950, p. 150; Wass, 1955, p. 144; Tabb and Manning, 1961, p. 596; Abele, 1970, p. 32; Rouse, 1970, p. 139; Lyons et al., 1971, p. 31; Menzel, 1971, p. 78; Chace, 1972, p. 103; Heard and Perlmutter, 1977, p. 40; Rodriguez, 1980, pp. 159, 160; Westinga and Hoetjes, 1981, pp. 139-150.

Material examined: HOURGLASS STATION C: 1 ♂, 3.7; 1 ♀, 4.0; 8 November 1965; dredge; FSBC I 28667. — 1 ♀, 3.3; 25 January 1967; trawl; FSBC I 28668. — HOURGLASS STATION K: 1 ♂, 4.0; 13 January 1966; trawl; FSBC I 28669. — 1 ♀ (with bopyrid), 4.1; 7 April 1967; trawl; FSBC I 18897. — FMG STATION 247: 28 ♂, 3.6-4.6; 19 ovig. ♀, 4.0-5.1; 2 ♂, 3.9 (with bopyrid), 4.5 (with hemiarthrine); 5 juv., 2.3-2.9; 26 m; 25 June 1979; *Spheciospongia vesparium*; USNM 189168. — OTHER MATERIAL: 116 ♂, 3.2-4.8; 141 ovig. ♀, 3.8-5.8; Curaçao; *Albatross*; SYNTYPES; USNM 38408.

Diagnosis: Rostrum (Figure 51b) reduced to small, triangular projection, well separated from broadly triangular but acuminate ocular hoods, ventral rostral process entirely lacking. Pleuron of first abdominal somite of male (Figure 52f) bearing very strong hooked tooth posteriorly, ventral margin of remaining 5 pleura strongly acute. Telson (Figure 52b) broad anteriorly, narrow posteriorly, with lateral margins concave in posterior 1/4; both pairs of dorsal spines arising in anterior 1/2 of segment. Stylocerite (Figure 51b, f) extending nearly to distal margin of first segment of antennular peduncle. Scaphocerite considerably exceeding lateral spine of basicerite, blade lacking; basicerite not armed dorsally. Palm of major chela (Figure 52c-e) terminating distodorsally in slender, acute spine; fixed finger short, not reaching nearly as far distally as movable finger. Dactyl of minor chela (Figure 51a) strongly tridentate distally in lateral view, dense fringe of

curved hairs present on extensor surface; fixed finger subequally bidentate distally, with obscure, obtuse third tooth proximal to well-developed anterior teeth, all situated in plane of chela; length of carpus about 1/2 that of chela. Carpus of pereopod 2 (Figure 53a) composed of 5 articles. Dactyls of posterior 3 pereopods (Figure 53c, e, g) with teeth subequal, proximal slightly divergent from distal. Lateral branch of uropod (Figure 52b) with single tooth proximal to movable spine.

Variation: Coutière (1909: 81, fig. 49) has already noted and figured variation in the abdominal pleura of female *S. pectiniger*. Both Hourglass females have pleura similar to those in his Figure 49c. Coutière evidently did not encounter other variation within this species, as it is one of the few for which he did not describe subspecies. Considerable variation exists, however, even in the relatively small Hourglass and Middle Ground collections. Most specimens lack sutural spines on the lateral branch of the uropod (Figure 52b), and some lack rostra (Figure 51f). Figure 52i illustrates, in a single specimen, the range of variation in the positioning of the spines on the dorsal surface of the telson.

Size (CL in mm): Males, 3.2-4.8; ovigerous females, 3.8-5.8; juveniles, 2.3-2.9.

Habitat: Hosts of the Hourglass material are unknown; the Middle Ground specimens are from a single *Spheciospongia vesparium*. Other specimens have been collected from *Spheciospongia vesparium* (Pearse, 1950; Menzel, 1971; Chace, 1972; Heard and Perlmutter, 1977; Westinga and Hoetjes, 1981); in channels near the periphery of a yellow sponge (Wass, 1955); and on turtle-grass flats and among mangrove roots (Chace, 1972). Lyons et al. (1971) reported specimens from a temperature of 17°C and a salinity of 24°/∞, and Tabb and Manning (1961) reported a single specimen from a salinity of 33°/∞. Hourglass specimens were collected from bottom temperatures ranging from 19.0 to 23.5°C and from bottom salinities ranging from 35.0 to 36.3°/∞. Florida Middle Ground specimens were collected from a bottom temperature of 25.2°C and a bottom salinity of 35.0°/∞.

Distribution: Atlantic: Bahama Islands (Coutière, 1909; Pearse, 1950), off central eastern Florida (R. H. Gore, pers. comm.) and Florida Keys (Coutière, 1909); Gulf of Mexico: Florida Bay (Tabb and Manning, 1961; Rouse, 1970), off southwest Florida (Coutière, 1909), off Crystal River, Florida (Lyons et al., 1971), Apalachee Bay (Menzel, 1971) and Alligator Harbor, Florida (Wass, 1955); Caribbean: Yucatan Peninsula (Chace, 1972), Virgin Islands (Coutière, 1909; Chace, 1972), Windward Islands (Chace, 1972), and the Netherlands Antilles (Coutière, 1909; Westinga and Hoetjes, 1981). Sublittoral (Chace, 1972) to a depth of 52 m (Westinga and Hoetjes, 1981).

Remarks: *Synalpheus pectiniger* is one of three species confused by Coutière (1898; 1899) under the names *S. laevimanus* var. *longicarpus* and *S. longicarpus* β.

Coutière (1909) noted that the eggs are very large and hatch as mysis larvae. He also mentioned (1909: 17, 18) a station with an excessive number of specimens (5000-6000, but mostly *S. longicarpus*; 547 *S. pectiniger*) in which females with anomalous eggs and abdominal pleura were greatly outnumbered by smaller-than-normal males. Specimens of *S. longicarpus* from this station were also anomalous (Coutière, 1907, 1909). Wass (1955) noted similar reproductive anomalies in a case involving cohabitation of a sponge by large numbers of these two species.

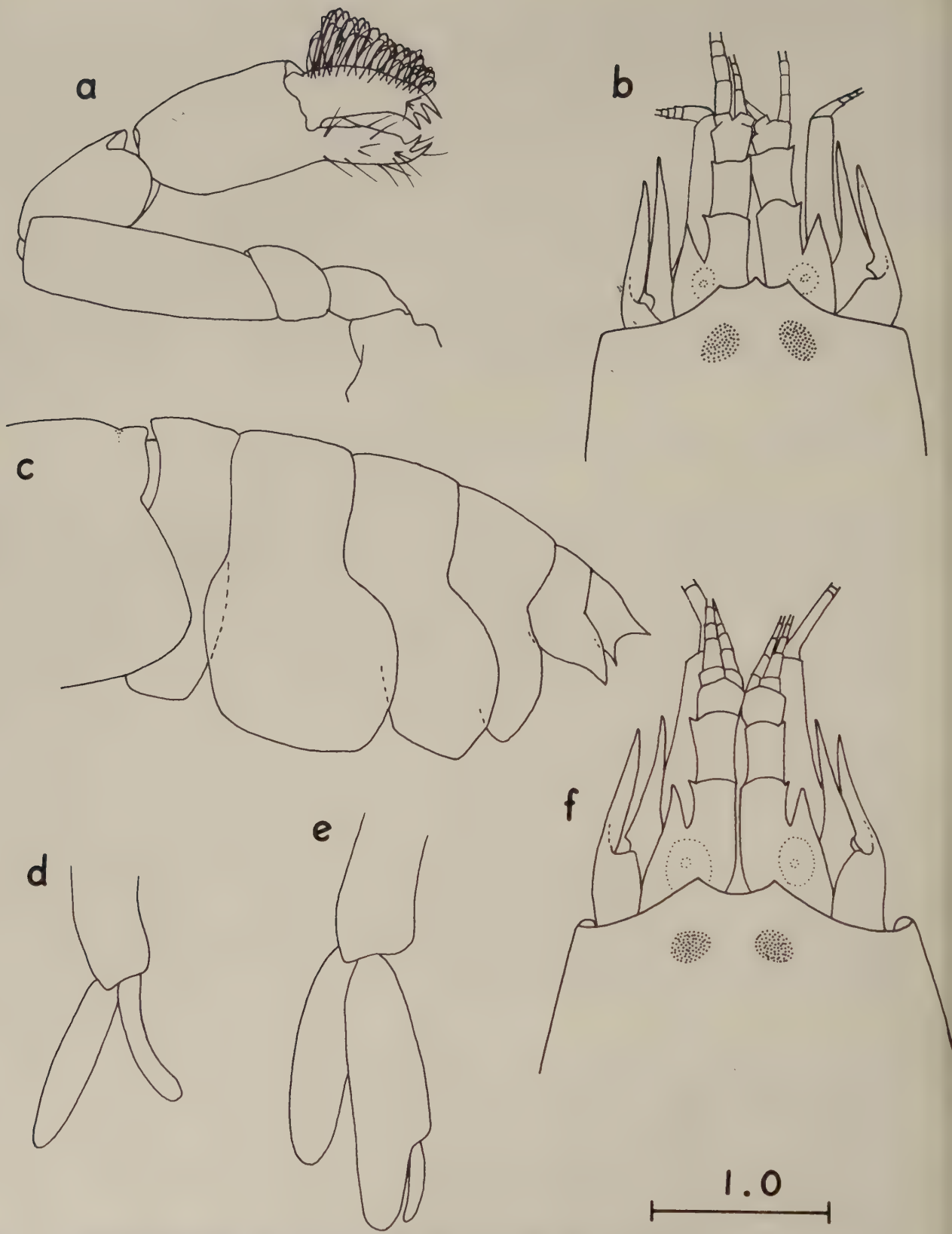

Figure 51. *Synalpheus pectiniger*, male, CL 4.5, USNM 189168; a. right minor chela; b. anterior region, dorsal view. Ovigerous female, CL 5.1, USNM 189168; c. abdomen; d. left pleopod 1; e. left pleopod 2; f. anterior region, dorsal view.

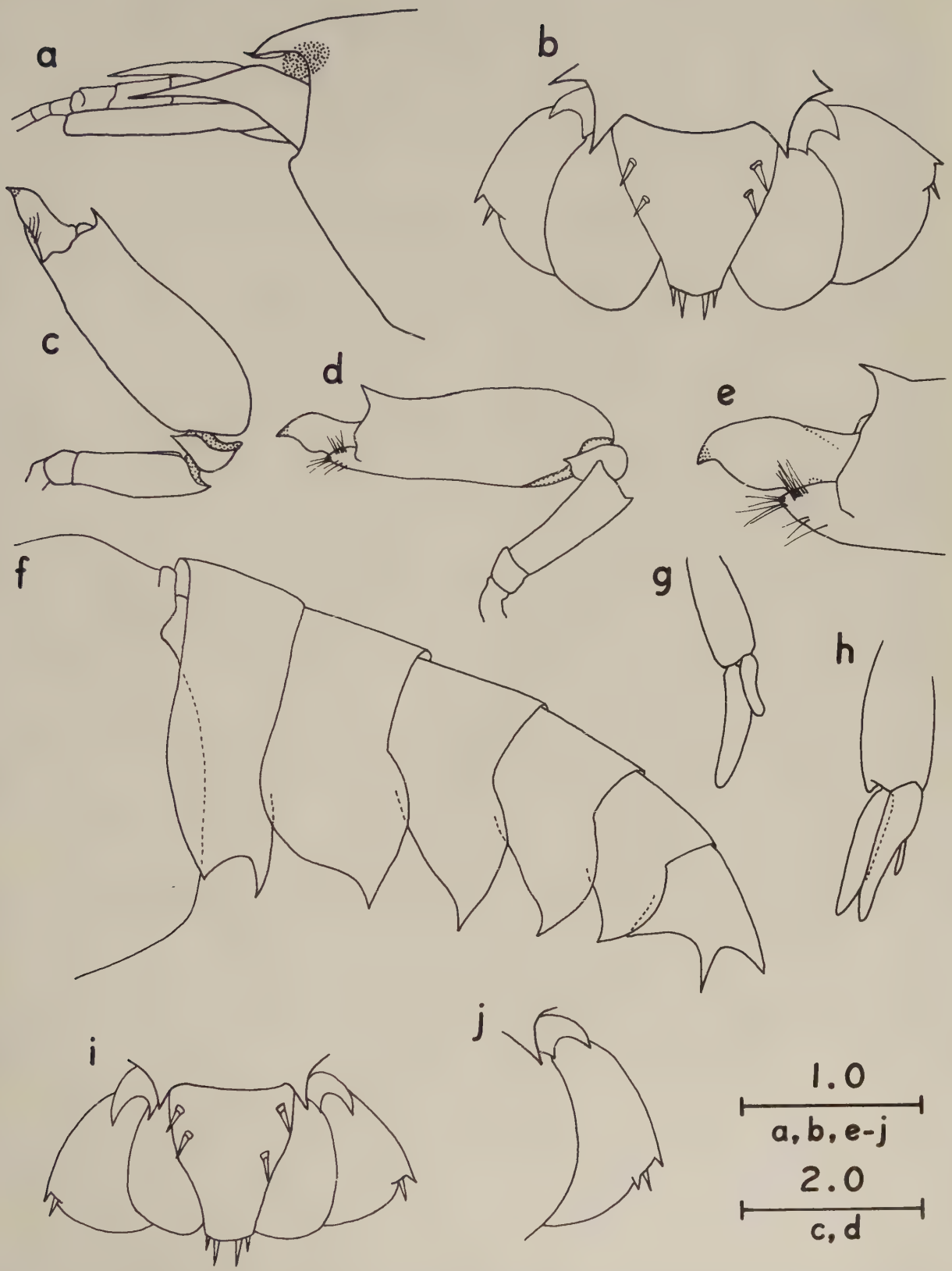

Figure 52. *Synalpheus pectiniger*, male, CL 4.5, USNM 189168; a. anterior region, lateral view; b. telson and uropods; c. left major chela, dorsal view; d. same, lateral view; e. same, lateral view of distal portion; f. abdomen; g. left pleopod 1; h. left pleopod 2. Male, CL 3.9, USNM 189168; i. telson and uropods. Male, CL 4.6, USNM 189168; j. right outer uropod.

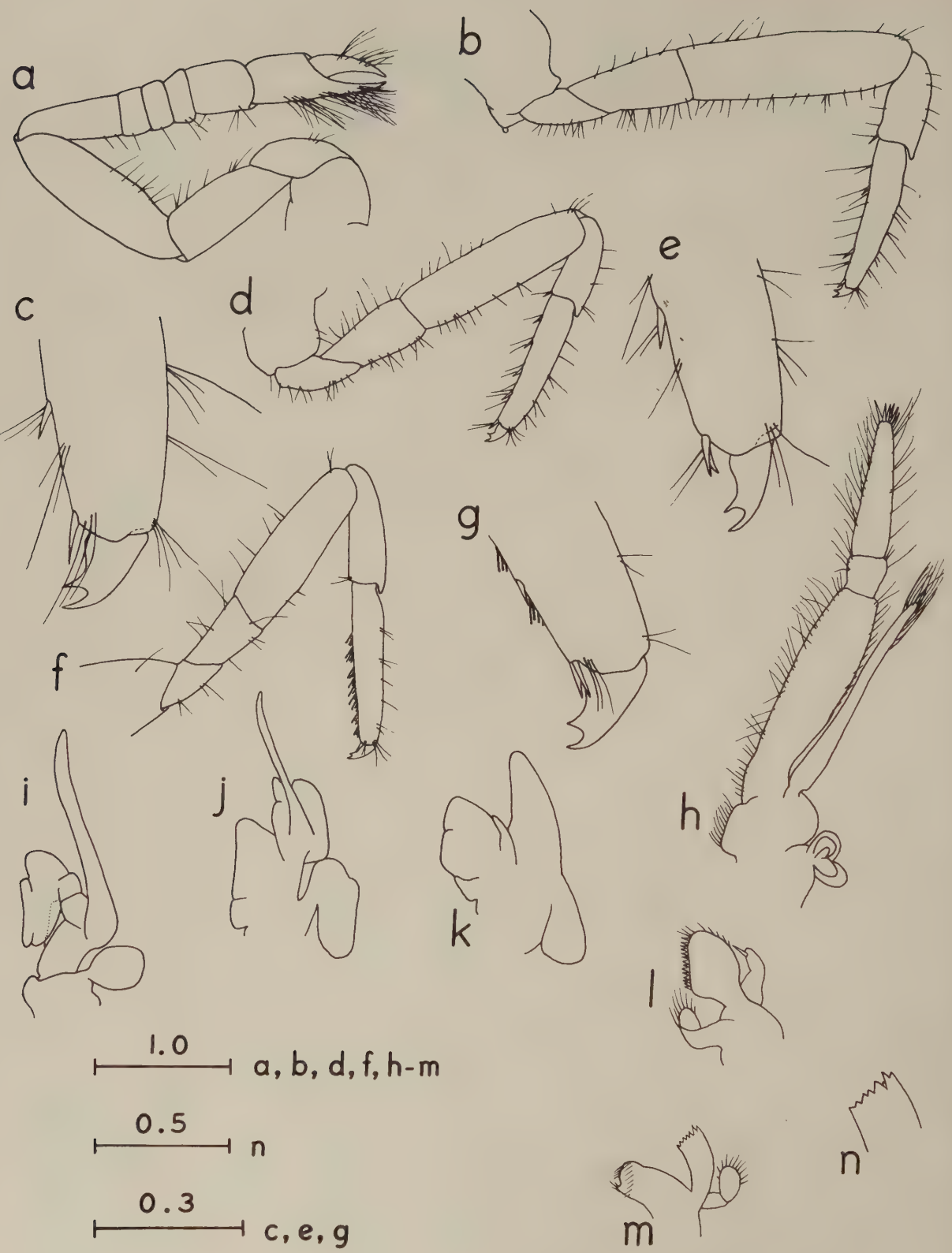

Figure 53. *Synalpheus pectiniger*, male, CL 4.5, USNM 189168; a. left pereopod 2; b. left pereopod 3; c. same, dactyl; d. left pereopod 4; e. same, dactyl; f. left pereopod 5; g. same, dactyl; h. left maxilliped 3; i. left maxilliped 2; j. left maxilliped 1; k. left maxilla 2; l. left maxilla 1; m. left mandible; n. same, incisor process.

Synalpheus rathbunae Coutière, 1909

Synalpheus laevimanus longicarpus: Rathbun, 1901, p. 110 [in part]. [Not *Alpheus laevimanus* Heller, 1862, =*Synalpheus gambarelloides* (Nardo, 1847); not *Alpheus saulcyi* var. *longicarpus* Herrick, 1891].

Synalpheus rathbunae Coutière, 1909, pp. 84, 85, fig. 51; Schmitt, 1935, p. 151; Monod, 1939, pp. 557, 558, figs. 1, 2; Pearse, 1950, p. 150; Chace, 1972, pp. 103, 104.

[?]*Synalpheus* near *rathbunae*: Schmitt, 1939, p. 28.

Not *Synalpheus* sp. (near *rathbunae* Coutière, 1909): Pequegnat and Ray, 1974 [=*Synalpheus agelas* Pequegnat and Heard, 1979].

Material examined: 9 ♂, 1.5-3.2; St. Thomas, Virgin Islands; 37-42 m; 6 February 1899; *Fish Hawk* Station 6079; SYNTYPES; USNM 38410.

Diagnosis: Rostrum slender, subequal to or slightly longer than and well separated from bluntly triangular ocular hoods, strongly produced ventrally between eyes. Pleura of all 6 abdominal somites of male acuminate posteroventrally. Telson broadly triangular, lateral margins concave in posterior 1/4; dorsal surface divided into 3 subequal parts by 2 pairs of strong spines. Stylocerite broad, extending just beyond midpoint of first segment of antennular peduncle. Scaphocerite considerably exceeding lateral spine of basicerite, blade completely lacking; basicerite armed with strong spine dorsally. Palm of major chela terminating dorsodistally in stout, conical spine directed somewhat dorsally. Fingers of minor chela simple, dactyl with dense fringe of curved hairs on extensor surface; length of carpus less than 1/2 that of chela. Carpus of pereopod 2 composed of 4 articles. Dactyls of posterior 3 pereopods with proximal tooth stronger than and markedly divergent from distal tooth. Lateral branch of uropod with 1 or 2 teeth proximal to movable spine.

Variation: Several of Coutière's syntypes have the lateral margins of the telson nearly straight. Chace (1972) noted two otherwise normal males with five carpal articles on pereopod 2, a female with only three carpal articles, and several large females, each with two minor chelae. The specimen from Guadeloupe illustrated by Monod (1939) has the stylocerite longer and more acute than that of the syntypes.

Habitat: On dead sponges (Coutière, 1909); within *Speciospongia vesparium* (Pearse, 1950). Chace (1972) reported this species from a variety of habitats, in coral and weeds, along shore and reef margins, and on turtle-grass flats.

Distribution: Atlantic: Bahamas (Pearse, 1950); Caribbean: Puerto Rico (Coutière, 1909; Schmitt, 1935), Virgin Islands (Coutière, 1909; Chace, 1972), Leeward Islands (Monod, 1939; Chace, 1972), Windward Islands, and Yucatan Peninsula (Chace, 1972). Distributed bathymetrically from less than 1 m (Chace, 1972) to about 40 m (Coutière, 1909).

Remarks: Coutière (1909) included the Puerto Rican (*Fish Hawk* Station 6064) specimens identified as *Synalpheus laevimanus longicarpus* by Rathbun (1901) in his material of *S. rathbunae*.

The specimen referred to as *Synalpheus* near *rathbunae* by Schmitt (1939) was not located; its identity is uncertain.

The specimens reported as *Synalpheus* sp. (near *rathbunae*) by Pequegnat and Ray (1974) were later described as a new species, *S. agelas*, by Pequegnat and Heard (1979).

Coutière (1909) noted that his female specimens were small, sterile, and had male pleura. Chace (1972) also noted reproductive anomalies in specimens from a particularly large lot.

Synalpheus sanctithomae Coutière, 1909

Synalpheus laevimanus longicarpus: Rathbun, 1901, p. 110 [in part]. [Not *Alpheus laevimanus* Heller, 1862, =*Synalpheus gambarelloides* (Nardo, 1847); not *Alpheus saulcyi* var. *longicarpus* Herrick, 1891].

Synalpheus sanctithomae Coutière, 1909, pp. 61, 62, fig. 35; Schmitt, 1935, p. 151; Chace, 1972, p. 104; Christoffersen, 1979, p. 352, figs. 29, 30; Gore, 1981, p. 152.

Material examined: 1 ♂, 3.2; 1 ovig. ♀, 3.3; off St. Thomas, Virgin Islands; 37-42 m; 6 February 1899; *Fish Hawk* Station 6079; SYNTYPES; USNM 24782.

Diagnosis: Rostrum narrowly triangular, extending slightly beyond triangular ocular hoods, convex ventrally. Pleura of first abdominal somite of male with hook-like tooth posteriorly, that of second broadly rounded, those of third and fourth rounded anteroventrally, angulate posteroventrally, that of fifth angulate, that of sixth acuminate. Telson subtriangular, lateral margins distinctly concave in posterior 1/4, dorsal surface divided into 3 subequal parts by 2 pairs of strong spines. Stylocerite reaching nearly to distal margin of first segment of antennular peduncle. Scaphocerite overreaching lateral spine of basicerite by less than 1/4 its length, blade well developed; basicerite not armed dorsally. Palm of major chela terminating dorsodistally in blunt tubercle armed secondarily with slender spine. Dactyl of minor chela obscurely bidentate distally, with dense fringe of curved hairs on extensor surface, fixed finger simple; length of carpus less than 1/2 that of chela. Carpus of pereopod 2 composed of 5 articles. Dactyls of posterior 3 pereopods with distal tooth stronger than proximal tooth. Lateral branch of uropod with single tooth proximal to movable spine.

Habitat: Rock and sand bottoms, from calcareous algae, sponges, and bryozoans (Christoffersen, 1979), and relict *Montastraea* (Gore, 1981).

Distribution: Atlantic: Florida Keys (Gore, 1981) and Brazil (Christoffersen, 1979); Caribbean: Virgin Islands (Coutière, 1909). Distributed bathymetrically from 18 m (Gore, 1981) to 51 m (Christoffersen, 1979).

Remarks: The specimen referred to as *Synalpheus laevimanus longicarpus* (*Fish Hawk* Station 6080) by Rathbun (1901) was included by Coutière (1909) in his material of *S. sanctithomae*.

Gore (1981) noted that, even after a year in preservative, the fingers of the major chela of a male were a distinct golden yellow color.

DISCUSSION

MORPHOLOGICAL VARIATION

Darwin's (1872: 60) observation that "systematists are far from being pleased at finding variability in important characters" is particularly appropriate to *Synalpheus*, where marked

variation has long frustrated workers attempting to differentiate species. Variation within the Gambarelloides group has been disparately accommodated by the erection of numerous subspecies (Coutière, 1909), and, conversely, by the synonymy of apparently discrete species (Christoffersen, 1979). Similar splitting and lumping in order to account for variability are found in this report. The question is far from settled; even large collections from widespread localities may not be sufficient to recognize specific limits. As Banner and Banner (1975: 276) stated after 20 years of experience with Pacific *Synalpheus*, "we are left with species that have been separated by subtle differences and that are variable in those characteristics used for their separation." Perhaps the margin of safety against environmental uncertainty provided by phenotypic variation is more important to population survival than precise adaptation to a particular set of conditions.

It is convenient to distinguish two types of variability in *Synalpheus*. The first is exemplified by aberrant numbers and placement of spines (Figures 11i, 12f), misshapen frontal regions (Abele, 1975: 77, fig. 31b; Coutière, 1909: 83, fig. 50a), atypical numbers of carpal articles (Banner, 1956: 336; Chace, 1972: 104), and similar anomalies. A particular aberration is often common to several specimens from an individual host, suggesting genetic drift and inbreeding. Although phenodeviants occur in practically all known taxa, the genes coding for external morphology in *Synalpheus* seem to be particularly flexible. Alternatively, members of the genus may be particularly susceptible to environmentally induced damage to developmental (i.e., ontogenetic) processes.

The second type of variability, the more conventional, continuous variation typical of large populations of outcrossing organisms, may be more responsible for the paucity of stable characters which distinguish species. Each of the Gambarelloides species are polymorphic to some degree in the relative and absolute lengths of the stylocerite, scaphocerite, basicerite, and antennal peduncle, the development of the blade of the scaphocerite, the shape of the ocular teeth, and the shape and armature of the telson and uropods. These features, however, usually vary within different ranges in each species, and, when combined with more stable characters such as the dentition of the fingers of the minor chela, serve to separate species. With the possible exception of the three, possibly disjunct, populations of *Synalpheus bousfieldi*, variation does not seem to be clinal in nature. Perhaps examination of material accompanied by detailed ecological data from widespread localities will correlate such variation with latitude, depth, temperature, or host species.

So little is known of mating, larval development, dispersal, host fidelity, trophic relationships, and interspecific competition among the various species of *Synalpheus* that any consideration of speciation is speculative, but it seems likely that both types of genetic variability are relevant to the diversity of the Gambarelloides group in the Gulf of Mexico and adjacent waters. The large number of species may result from adaptive radiation of the type postulated by Banner (1953), where the variability accompanying the adaptation to a series of different niches has not yet been stabilized by natural selection (Williams, 1975). Banner and Banner (1966) have pointed out that, given the physical protection afforded commensal species, minor variation may not be selected against as rigorously as in free-living species. In addition to the usual opportunities for speciation offered by a reservoir of morphological variation, species which may be easily isolated from gene flow admit the possibility of phenodeviation, an important mechanism in quantum speciation (Grant, 1977). Bruce (1976a) postulates that juveniles, unable to locate usual hosts, may settle on a new host species. Conditioning of the offspring of a founding pair by a "host factor", combined with the discontinuous, insular nature of a host organism, could result in the restriction of gene flow and initiate relatively rapid speciation (Davenport, 1955).

Finally, no discussion of variability and speciation in *Synalpheus* would be complete without the tongue-in-cheek remark by Stebbing (1915: 85): "as the eyes are completely covered by the carapace the vision of these creatures must be dim, and without compasses the members of different species will never know one another apart. Perhaps indeed the numerous varieties may be the result of inconsiderate intermarriages."

REPRODUCTION

It seems likely that mating behavior in *Synalpheus* is similar to that described for related shrimps (Herrick, 1891; Nouvel and Nouvel, 1937; Bauer, 1976). Females with egg-filled ovaries become attractive to males and receptive to mating following completion of a molt, usually within a few hours after the hatching of the previous brood. The male recognizes a receptive female through contact with his antennae, climbs astride the dorsal midline of the female, swings 90 degrees and brings his thoracoabdominal junction beneath and perpendicular to the female's first abdominal sternite. Lacking the setae specialized for spermatophore transfer described for *Heptacarpus pictus* (Stimpson, 1871) by Bauer (1976), *Synalpheus* species probably pass the spermatophore directly from the genital orifices to the sternum of the female. Egg-laying commences within a few minutes of mating.

Incubation periods, at least for *Synalpheus brooksi*, are relatively long, at least 59 days under laboratory conditions (Dobkin, 1965). Most Gambarelloides species have small clutches, fewer than 25 eggs per brood (Coutière, 1909). Coutière (1909) examined late stages of developing embryos and determined that *Synalpheus goodei*, *S. longicarpus*, *S. pandionis*, and *S. paraneptunus* hatch as "zoeae" whereas *S. brooksi*, *S. herricki*, and *S. pectiniger* hatch as "mysis." Although poecilogony has been suggested (Herrick, 1891; Chace, 1972) and refuted (Coutière, 1909; Christoffersen, 1979), there are still no unambiguous examples among the species of *Synalpheus*. There is some indication, however, that variation in larval development exists. Both Gurney (1949) and Dobkin (1965; 1969) pointed out that a molt which occurs soon after hatching, rather than before, adds an extra instar. In any case, all Gambarelloides species for which larval histories have been investigated have either an abbreviated or a direct development (Dobkin, 1969).

Felder (1982) suggested that two non-Gambarelloides species of *Synalpheus* achieve sexual maturity within a year of hatching; this seems to be true of Gambarelloides species as well (Figures 16, 45). Adult females are found in a 1:1 correspondence with males, and virtually all are ovigerous. Reproduction appears to be continuous throughout the year for the entire population of each species for which adequate material is available. Since there is no seasonal component, minor fluctuations in reproductive intensity (Figures 17, 46) are probably not due to changes in environmental conditions. However, fecundity may have been reduced during winter months by a reduction in brood size; eggs could not be accurately enumerated because of losses associated with extensive handling. Recruitment occurs year-round in all species sampled in sufficient numbers for analysis.

Secondary sex characters are sometimes difficult to interpret in *Synalpheus*. The appendix masculina, found on the second pleopod of males of most other Caridea, is lacking in both sexes. Coutière (1909) mistakenly attributed several characters, including the absence of the blade of the scaphocerite and variation in the carpus/chela ratio of the minor first pereopod, to sexual dimorphism in some species of *Synalpheus*. Sex of an individual, however, can be reliably determined

only by differences in the ventral margin of the first abdominal pleuron, the shape and size of the endopod of the first pleopod, and the position of the appendix interna on the endopod of the second pleopod. Genital apertures are generally indistinguishable under conventional magnification.

The largest individuals of each species examined were always female (Figures 16, 45). As is the case with most carideans, females have longer and stouter abdomens than do males (Coutière, 1909). In addition, females tend to have slightly longer carapace lengths than their mates. Juveniles of both sexes are indistinguishable from males. They are best separated from mature males by measuring a large series of various sizes and carefully considering demographic representation. This leads to some ambiguity at intermediate sizes, but sexual differentiation is not apparent except in adult females. Adult females have the posteroventral margin of the first abdominal pleuron evenly rounded, the endopod of the first pleopod relatively long and equally wide over its entire length, and the appendix interna situated about midlength on the endopod of the second pleopod (Figure 51d, e). Males and juveniles have the posteroventral margin of the first abdominal pleuron produced into a curved hook, the endopod of the first pleopod short and much wider in the distal half, and the appendix interna of the second pleopod positioned more basally than in females (Figure 52g, h). These sexually dimorphic characters are compared in each of the species illustrated (see species accounts). The hook-like tooth on the first abdominal pleuron is more pronounced in some species than in others. It is particularly prominent in *S. longicarpus*, *S. rathbunae*, and *S. pectiniger*; males of these three species also have the ventral margins of the remaining pleura spinous.

Minute, chalky, spherical objects, usually referred to as infertile eggs, occur in females of at least nine western Atlantic species of *Synalpheus*. Coutière (1907; 1909) noted marked sterility and masculinization of small females of *S. brooksi*, *S. pectiniger*, and *S. rathbunae*. He suggested that the reduced fecundity and the apparent excess of males were due to crowded conditions, castration by a microsporidian parasite, or, perhaps, insufficient food. Chace (1972) also observed infertile eggs carried by specimens of *S. brooksi* and *S. rathbunae* but offered no explanation for the phenomenon. Felder (1982) found infertile eggs on small females of *S. apioceros*, a tropical, non-Gambarelloides species, collected during late fall and winter months in the northwestern Gulf of Mexico. Concurrent collections of *S. fritzmuelleri*, a temperate, non-Gambarelloides species, produced females with only normal eggs. He attributed the infertile eggs to a physiological restriction of reproductive activity in the tropical species, resulting from decreasing winter temperatures coinciding with maturation of young-of-the-year females. Females of the species treated herein were carefully examined, and infertile eggs were found in specimens of *Synalpheus heardi*, *S. agelas*, *S. brooksi*, *S. bousfieldi*, *S. pandionis*, and *S. paraneptunus*.

All cases of infertile eggs among species of *Synalpheus* involved subadults, presumably female and almost certainly young-of-the-year. Infertile eggs were found on only a few immature individuals of *Synalpheus heardi*, *S. agelas*, *S. bousfieldi*, and *S. paraneptunus*. In *S. pandionis*, the externally undifferentiated size class between juveniles and mature adults carried fertile eggs, but several even smaller specimens bore infertile eggs. Infertile eggs of *S. brooksi*, however, like those of *S. apioceros*, occurred in a rather larger percentage of the subadult population. Unlike *S. apioceros*, production of infertile eggs in *S. brooksi* seemed to be independent of season. In any given month, as many as 50% of the subadult size class carried infertile eggs. As Felder (1982) pointed out, it is unlikely that a single hypothesis will account for the seemingly wasteful production of nonviable eggs by each of several species. Several ideas, outlined below, should be appended to the theories already proposed.

Acquisition of sexual characters in crustaceans is a gradual process. Charniaux-Cotton (1965) noted that external sexual differentiation lags behind gonadal maturity. It has already been pointed out that female *Synalpheus* are usually larger than their mates. If young females mate with smaller males, possibly a female which has barely reached genital maturity could not be successfully fertilized by the immature male, resulting in a brood of infertile eggs. Or, young females may have mature ovaries but not yet be attractive or receptive to males, with the same result. Nouvel and Nouvel (1937) found that females of seven caridean species, including one alpheid, spawned within a few days of a reproductive molt, despite male deprivation. The unfertilized eggs lacked the adhesive properties of fertile eggs and either fell away or were removed by the female.

Both Coutière (1907) and Wass (1955) reported reduced fecundity, but not infertile eggs, in dwarf specimens of *Synalpheus* under crowded conditions. Banner and Banner (1975) suggested that a pheromone-like chemical given off by the host might inhibit growth and maturity. Alternatively, the pheromone could be released by the shrimp themselves, in response to population densities too high for prevailing conditions. Females with infertile eggs were more common in Bahamian populations of *Synalpheus heardi* and *S. bousfieldi*. Significantly, even mature females of these two species were much smaller in the Bahamas than conspecifics in the Gulf of Mexico, although population densities were not noticeably higher. Both the small size and the infertile eggs may have been related to suboptimal environmental conditions or to a nutritional deficiency.

The possibility of environmentally influenced sexual lability suggested by Felder (1982) should be investigated further. The bipotentiality of crustacean gonia is well known (Bacci, 1965). Functional sex seems to be determined ultimately by the presence or absence of androgenic hormone (Charniaux-Cotton, 1965). Production of the hormone is genetically determined, but every individual possesses all the genes involved in both male and female morphogenesis. Although evidence of its occurrence in *Synalpheus* is scant, the adaptive advantage of indeterminate sex in juveniles of a commensal species is obvious.

COMMENSAL ASSOCIATIONS

The term commensalism is used herein in a general sense to describe a broad spectrum of interspecific associations. Inquilinism, simple sharing of the same space without trophic implications, is regarded as the most basic relationship. Because so little is known about trophic interrelationships of coral reef hosts and their cryptofauna, it is the most easily demonstrated commensal association among *Synalpheus* species. These species undoubtedly utilize the host as a feeding site, probably feeding on the associated microflora and fauna. In addition, the host itself may provide a source of nutrition, but, until details of the trophic strategies of the inquilines are disclosed, the degree of interdependence with the host will remain unclear. It is probable that a wide variety of relationships are involved.

Several morphological adaptations to a commensal lifestyle are shared by species of *Synalpheus*. The reduction of the rostrum and loss of the thoracic armature facilitate movement within the host. Biunguiculate dactyls on short, stout limbs allow a firm connection with the host substrate. The disproportionately large major chela is a defensive adaptation which may function as an operculum by blocking the channel of the sponge in which the shrimp is living. Dentate fingers of the minor chela, common among the sponge-dwelling Gambarelloides species, may be

used to tear off pieces of host tissue (Banner and Banner, 1975). The abbreviated larval development exhibited by Gambarelloides species is unusual among coral reef Caridea; in the Pontoniinae, more highly specialized commensal species usually have large numbers of small ova (Bruce, 1972). When larval stages are supressed, larval dispersal is necessarily rather local. Juvenile shrimp may even colonize the parents' host (Dobkin, 1965). Behavioral adaptations include generalized positive thigmotactic and negative phototrophic responses in at least one species (McClendon, 1911). *Synalpheus hemphilli*, a non-Gambarelloides species which occurs as a mated pair alone within the host sponge, exhibits intense intraspecific agonistic behavior (Hazlett and Winn, 1962). Gambarelloides species, which may share a host with several hundred individuals of as many as five other congeneric species, presumably lack this territorial response. Many convergent behavioral and morphological adaptations to a commensal existence are found in species of Pontoniinae (see Bruce, 1976b, for review).

Mechanisms of host selection and colonization by species of *Synalpheus* are unknown. Information on habitat specificity, however, is gradually accumulating (see species accounts). Community structure within a host species seems to vary with locality (see Abele, 1979; compare Pearse, 1932b, with Westinga and Hoetjes, 1981). Even within a restricted area, some species are found on a variety of hosts (Pearse, 1932b, 1950).

Examination of large series of host sponges from the Florida Middle Ground revealed three broad categories of cryptofaunal shrimps, separated by the degree of host specificity. Group I consists of casual or accidental associates. These species occur fortuitously on a wide variety of hosts or may be free-living. Group I species prefer a cryptic environment but are not necessarily restricted to sponges, or even to living hosts. The two remaining groups are, to differing degrees, more dependent on living hosts. So little is known of the life histories and trophic relationships of species of *Synalpheus* that the degree of dependence can only be inferred from the community structure in the sponges examined and by the degree to which a shrimp is associated with a single host. Group II contains facultative commensals which occur frequently within a particular host but which are not limited to it. These species can form complex communities involving up to six species of *Synalpheus*. Although they may occur in other habitats, these shrimp are consistently present in fixed interspecific ratios within their host sponges. Group III species are obligate commensals of a single host, or of a few closely related host species (i.e., *Ircinia* spp.), which meet the exacting criteria proposed by Garth (1975) for a clear organism-host relationship. In these species, (1) association with the living host is constant, (2) free-living individuals do not normally occur, and (3) all stages of postlarval life, including adult breeding individuals, are present in the host. Each species of *Synalpheus* collected from the Florida Middle Ground is categorized with respect to its host sponge in Table 10. Notice that Groups I and II are not mutually exclusive.

The above groups are also applicable to coral associates (Abele, 1976). Four species of corals, *Madracis decactis*, *Oculina diffusa* Lamarck, 1816, *Stephenocoenia michelini* Milne-Edwards and Haime, 1848, and *Cladocora arbuscula* (LeSueur, 1820) were examined; only *M. decactis* yielded *Synalpheus* other than *S. townsendi*. With respect to *M. decactis* (Table 11), *Synalpheus townsendi*, *S. pandionis*, and *S. scaphoceris* belong to Group II, *S. goodei* and *S. herricki* belong to Group I. No western Atlantic *Synalpheus* is known to be an obligate commensal of anthozoan coelenterates.

Synalpheus is by far the most species-rich genus of shrimps found in the Middle Ground biotope. Within the sponge, *Agelas dispar*, species of *Synalpheus* accounted for the six most abundant species and 99% of all individuals (Table 12). In *Madracis decactis*, three of the five most abundant species were *Synalpheus*, as were over 75% of the individuals (Table 11). The

TABLE 10. OCCURRENCE OF SPECIES OF *Synalpheus* IN SPONGES COLLECTED FROM THE FLORIDA MIDDLE GROUND; THE SYMBOL (I) INDICATES A CASUAL OR FORTUITOUS ASSOCIATION, (II) INDICATES CONSISTENT OCCURRENCE IN A FIXED RATIO, AND (III) REPRESENTS AN OBLIGATE RELATIONSHIP. (?) REFERS TO AN UNCERTAIN RELATIONSHIP.

	Agelas dispar	*Spinosella vaginalis*	*Callyspongia fallax*	*Aplysina fistularis*	*Ircinia felix*	*Ircinia campana*	*Ircinia strobilina*	*Aiolochroia crassa*	*Spheciospongia vesparium*
S. agelas	III								
S. bousfieldi	II								
S. brevicarpus						?I	?I		
S. brooksi	II								II
S. goodei	I								
S. heardi						?I			
S. hemphilli		III							
S. herricki	II								
S. longicarpus	I								II
S. minus								?I	
S. pandionis	II								
S. pectiniger									II
S. townsendi	II	I	I	I	I	I	I	I	

abundance and diversity of the genus heavily influences the structure of the cryptofaunal shrimp communities associated with these two host species.

Community structure generally follows trends outlined in other cryptofaunal studies (McCloskey, 1970; Abele and Patton, 1976; Uebelacker, 1977; Westinga and Hoetjes, 1981; Reed et al., 1982). Crustaceans comprise a significant portion of the macrofaunal assemblages associated with *Agelas dispar* and *Madracis decactis*. Dominant carideans are not necessarily obligate members of the community but breed and possibly complete their entire life cycles within the host. Numbers of both species and individuals of carideans correlate positively with host volume (Table 13). Small hosts have fewer species and smaller individual species population sizes. Although many factors which determine the composition of cryptofaunal communities remain to be discovered, it is clear that species/volume phenomena are important.

In addition to the influence of volume on species richness and total abundance of communities within *Agelas dispar*, other factors must act to regulate species composition and relative abundance. The caridean community associated with *Agelas dispar* collected from the Bahama Islands (Table 14) is quite different from the corresponding community from the Florida Middle

TABLE 11. CARIDEAN COMMUNITY ASSOCIATED WITH *Madracis decactis*. TEN SAMPLES OF VARYING SIZES WERE TAKEN DURING EACH OF THREE SEASONS (JAN., JUNE, OCT.) FROM THE FLORIDA MIDDLE GROUND.

	Frequency of Occurrence		Abundance		Density	Size Range of Hosts
	n	%	n	%	(n/l)	(ml)
Synalpheus townsendi	28	93.3	307	63.7	12.3	118-2774
Alpheopsis labis	17	56.7	51	10.6	2.0	382-2774
Thor manningi	18	60.0	44	9.1	1.8	148-2774
Synalpheus pandionis	7	23.3	21	4.4	0.8	208-2774
Synalpheus scaphoceris	7	23.3	17	3.5	0.7	268-2774
Synalpheus spp. (postlarvae)	10	33.3	12	2.5	0.5	208-1860
*Synalpheus agelas**	3	10.0	6	1.2	-	-
*Periclimenaeus bredini**	1	3.3	5	1.0	-	-
Synalpheus goodei	1	3.3	4	0.8	0.2	2274
Periclimenes iridescens	3	10.0	4	0.8	0.2	253-617
Periclimenes americanus	2	6.7	2	0.4	-	452, 1878
Typton prionuris	1	3.3	2	0.4	-	1068
Typton sp. (juv.)	1	3.3	1	0.2	-	1052
Periclimenaeus chacei	1	3.3	1	0.2	-	1624
Periclimenaeus maxillulidens	1	3.3	1	0.2	-	1352
*Periclimenaeus perlatus**	1	3.3	1	0.2	-	-
Periclimenaeus sp. (juv.)	1	3.3	1	0.2	-	1878
Alpheus floridanus	1	3.3	1	0.2	-	1249
Synalpheus herricki	1	3.3	1	0.2	-	1878

*From sponge attached to *M. decactis*.

TABLE 12. CARIDEAN COMMUNITY ASSOCIATED WITH *Agelas dispar*. TEN SAMPLES OF VARYING SIZES WERE TAKEN DURING EACH OF THREE SEASONS (JAN., JUNE, OCT.) FROM THE FLORIDA MIDDLE GROUND.

	Frequency of Occurrence		Abundance		Density	Size Range of Hosts
	n	%	n	%	(n/l)	(ml)
Synalpheus townsendi	29	96.7	368	40.8	19.2	108-3237
Synalpheus agelas	28	93.3	335	37.1	17.4	32-3237
Synalpheus spp. (postlarvae)	25	83.3	144	16.0	7.4	32-3237
Synalpheus pandionis	14	46.7	26	2.9	1.4	32-3237
Synalpheus bousfieldi	5	16.7	9	1.0	0.5	443-1479
Synalpheus brooksi	3	10.0	6	0.7	0.3	863-3237
Synalpheus herricki	2	6.7	4	0.4	0.2	728, 3237
Thor manningi	2	6.7	3	0.3	0.2	222, 1198
Synalpheus goodei	1	3.3	2	0.2	0.1	1198
Synalpheus longicarpus	1	3.3	1	0.1	-	798
Neopontonides beaufortensis	1	3.3	1	0.1	-	222
Periclimenaeus maxillulidens	1	3.3	1	0.1	-	842
Alpheopsis labis	1	3.3	1	0.1	-	842
Lysmata sp. (juv.)	1	3.3	1	0.1	-	198

TABLE 13. CORRELATION COEFFICIENTS (*r*) AND F-DISTRIBUTION VALUES, WITH ASSOCIATED PROBABILITIES OF ERROR (P), FOR CORRELATIONS BETWEEN SPECIES RICHNESS AND ABUNDANCE OF CRYPTOFAUNAL CARIDEANS AND HOST VOLUME FOR *Agelas dispar* AND *Madracis decactis* FROM THE FLORIDA MIDDLE GROUND.

	Agelas dispar (n=30)		*Madracis decactis* (n=30)	
	r	F	*r*	F
Species Number vs. Host Volume	0.422 P<0.020	6.07 P<0.020	0.749 P<0.001	35.88 P<0.001
Number of Individuals vs. Host Volume	0.882 P<0.001	98.22 P<0.001	0.816 P<0.001	55.98 P<0.001

Ground (Table 12). Five species of *Synalpheus* and five non-*Synalpheus* carideans occurred at the Florida Middle Ground but not at Grand Bahama Island. Bahamian *Agelas* did not harbor non-*Synalpheus* carideans. Of the three species common to both habitats, only one, *Synalpheus agelas*, the only obligate caridean commensal of *A. dispar*, is found in comparable abundance and density. Although *S. bousfieldi* and *S. townsendi* are found at both localities, each is dominant at one and relatively rare at the other. Two species, *S. heardi* and *S. macclendoni*, occur in *A. dispar* from the Bahamas but not from the Florida Middle Ground. Colonization, indicated by the density of postlarval specimens, is three times greater in *Agelas* from the Middle Ground. The cause of these differences is unknown, but differing environmental conditions, perhaps on a micro-scale, seem to be the most likely explanation.

TABLE 14. CARIDEAN COMMUNITY ASSOCIATED WITH *Agelas dispar*. FOURTEEN SAMPLES WERE TAKEN DURING NOVEMBER 1975 FROM THE BAHAMA ISLANDS.

	Frequency of Occurrence		Abundance		Density	Size Range of Hosts
	n	%	n	%	(n/l)	(ml)
Synalpheus bousfieldi	12	85.7	124	37.0	14.4	200-1564
Synalpheus agelas	13	92.9	109	32.5	12.6	33-1564
Synalpheus heardi	8	57.1	42	12.5	4.9	415-1564
Synalpheus townsendi	6	42.8	29	8.7	3.3	617-1564
Synalpheus spp. (postlarvae)	7	50.0	21	6.2	2.4	671-1564
Synalpheus macclendoni	2	14.3	10	3.0	1.2	200, 690

ZOOGEOGRAPHY

The zoogeographic status of the Gulf of Mexico, bounded by a warm-temperate region to the north and two tropical provinces to the south (Briggs, 1974), has long been unsettled. Faunal elements of each zoogeographic unit undeniably inhabit its waters, but the dominance of a temperate or a tropical component seems dependent on the particular taxon examined. Various

authors have aligned the Gulf with the Carolinean Region (Briggs, 1974), considered it to be a transitional area (Spivey, 1981), or even regarded it as a separate province altogether (Hopkins, Blizzard and Gilbert, 1977). All of the preceding classifications, however, are predicated on an inadequate data base. As Briggs (1974) pointed out, the Gulf of Mexico, with the sole exception of Alaska, is faunistically the least known of the North American coasts. Thus, it is incumbent upon workers in the area to consider the affinities of their groups in the hope of contributing to the resolution of a complex issue.

Known distributions of the western Atlantic Gambarelloides species of *Synalpheus* are summarized in Table 15. Several general distribution patterns may be discerned. *Synalpheus longicarpus*, *S. brooksi*, *S. pectiniger*, and *S. pandionis*, the most widely distributed species, are found between the southern coast of North America and the northern coast of South America. In addition, *S. longicarpus* ranges as far north as North Carolina. *Synalpheus goodei*, *S. bousfieldi*, and possibly *S. paraneptunus* also have similarly great latitudinal ranges but display some curious gaps in the center. These gaps may actually separate populations, or may simply reflect inadequate collecting. *Synalpheus goodei* is the only Gambarelloides species known with certainty from Bermuda. Another group of species, *Synalpheus herricki*, *S. heardi*, and *S. agelas*, have principally Gulf of Mexico distributions. The latter two species are also represented by dwarf populations in the Bahamas, and *S. agelas* has been found off Puerto Rico. *Synalpheus macclendoni*, *S. disparodigitus*, *S. rathbunae*, and *S. sanctithomae* are not easily categorized; all are known from only a few specimens from scattered localities. The remaining Gambarelloides species, *S. androsi*, *S. barahonensis*, *S. filidigitus*, *S. brevifrons*, and *S. anasimus*, are known only from their type-localities, all, with the exception of *S. androsi*, within the Caribbean Sea. Bathymetric ranges of the Gambarelloides species are similar; most range from very shallow water out to the middle of the continental shelf.

Each geographic subunit in Table 15 is assigned to one of five faunal provinces at the bottom of the table. The Gambarelloides group is poorly represented in the Brazilian Province and the Carolinean Region; however, the West Indian Province contains 17 of the 19 species known from the Tropical Western Atlantic Region, the Caribbean Province contains 11 species, and the Gulf Province contains 10. Bray-Curtis similarity indices reveal that the faunae of the three central provinces differ only slightly (Table 16). The Caribbean and West Indian faunae are the most similar; both are equally similar to the Gulf fauna. In general, there seem to be no clear-cut faunal barriers to Gambarelloides species within the northern portion of the Tropical Western Atlantic Region.

The tropical complexion of Gulf of Mexico Gambarelloides populations is clear. The Gulf is bounded by a discontinuous series of hard banks which support living corals and their associated communities (Figure 2). Warm-water and tropical recruits are provided seasonally by the Loop Current. Winter temperatures are moderated by the depth at which most hard bank communities occur. The strong tropical component of offshore continental shelf populations in the Gulf has been noted by Collard and D'Asaro (1973). Cerame-Vivas and Gray (1966) noted a similar submergence of the tropical fauna found off North Carolina. Usually associated with the reef biotope, most Gambarelloides species probably occur throughout the Gulf, wherever suitable habitat is present.

In addition to the nineteen western Atlantic species whose distributions are summarized in Table 15 and at least two species from the Gulf of California, four Gambarelloides species are distributed in extra-American waters: *Synalpheus parfaiti* from West Africa, *S. gambarelloides* from throughout the Mediterranean, *S. sladeni* from the Gulf of Aqaba and Carados

TABLE 15. KNOWN DISTRIBUTIONS OF THE GAMBARELLOIDES SPECIES OF *Synalpheus* FROM THE WESTERN ATLANTIC REGION.

	Bathymetric Distribution	Geographic Distribution*										
		1	2	3	4	5	6	7	8	9	10	11
S. longicarpus	<1-73 m	?	X	X	X	X	X	X	X	X	X	
S. brooksi	0.5-73 m	X	X	X	X	X	X	X	X	X		
S. pectiniger	0.5-52 m		X	X	X	X	X	X	X	X		
S. pandionis	<1-73 m	?	X	X	X	X		X	X	X		
S. goodei	0.5-73 m		X	X	X	X			X	X		X
S. bousfieldi	3-55 m	?		X		X	X		X	X		
S. paraneptunus	0.3-77 m		X	X	X	X			?	?		
S. herricki	6-73 m						?		X	X		
S. heardi	21-73 m						X		X	X		
S. agelas	20-69 m					X	X			X		
S. macclendoni	1-23 m			X	X		X		X	X		
S. disparodigitus	?(shallow)				X	X						
S. rathbunae	<1-40 m			X	X	X	X					
S. sanctithomae	18-51 m	X				X		X				
S. androsi	?						X**					
S. barahonensis	?(shallow)					X**						
S. filidigitus	?(shallow)					X**						
S. brevifrons	1 m				X**							
S. anasimus	1.5-3 m			X**								

Brazilian Province --------
Caribbean Province ----------
West Indian Province ----------
Gulf Province ----------
Carolinian Region -------

*1 = Surinam; Brazil
2 = North coast of South America; Netherlands Antilles
3 = Panama; Central America north to Cabo Catoche, Yucatan Peninsula
4 = Lesser Antilles; Barbados
5 = Cuba; Hispaniola; Puerto Rico; Virgin Islands
6 = Bahama Islands
7 = Central and SE Florida; Florida Keys
8 = SW Florida including Dry Tortugas, to Tampa Bay
9 = NW Florida; northern Gulf of Mexico south to Cabo Catoche, Yucatan Peninsula
10 = NE Florida; Georgia; South Carolina; North Carolina
11 = Bermuda

**Known only from the type-specimens

Carajos Shoals in the Seychelles-Mauritius Ridge, and *S. spongicola* from the Red Sea. The Gambarelloides group generally follows the Eastern Atlantic-Caribbean generalized track discussed by Rosen (1975). A generalized track estimates the geographical distribution of an ancestral biota prior to differentiation into descendant biotas (Croizat, Nelson and Rosen, 1974). In this case, an ancestral species, during the early Mesozoic, with a range coincident with the distribution of the Gambarelloides group in the Tropical Western Atlantic Region today, would not only occur along the then adjacent African coast but would also have ready access to the Eastern Pacific [see Malfait-Dinkelman model in Rosen (1975: 450)]. Furthermore, the proto-Antilles are hypothesized to have been, at that time, represented by a volcanic archipelago connecting North

TABLE 16. BRAY-CURTIS FAUNAL SIMILARITIES OF GAMBARELLOIDES *Synalpheus* POPULATIONS FROM THREE WESTERN ATLANTIC WARM WATER PROVINCES.

	Caribbean Province	West Indian Province
Gulf Province	0.67	0.67
Caribbean Province		0.71

and South America. Subsequent geological events dispersed the proto-Antilles to their present positions, opened the Atlantic Ocean between Africa and South America, and nearly closed the Isthmus of Panama by the Pleistocene. Given the obviously rapid evolutionary rate of Gambarelloides species, it is not surprising that the Gulf of California and Eastern Atlantic representatives belong to different species. It is surprising, however, that the differentiation of many, many species within the newly formed Caribbean Sea was not repeated along the now distant African coast and the presently isolated Gulf of California. The Gambarelloides species from the Mediterranean, Red Sea, and the Indo-Pacific, also perhaps descendants of a pan-Tethyan ancestor, likewise did not undergo the explosive speciation which occurred in the Western Atlantic Region.

STATION AND SPECIES ASSOCIATIONS

Eight of the eleven Gambarelloides species of *Synalpheus* known from the Gulf of Mexico were captured during regular (nighttime) Hourglass sampling. With the exception of *S. pectiniger*, each species was numerically more abundant on the southern transect than on the northern transect (Table 17). Joyce and Williams (1969) considered Hourglass stations of the same depth similar enough to combine general descriptions of the station pairs. If temperature differences rather than habitat differences are responsible for dissimilar intertransect abundances, the situation is more complex than simple exclusion or restriction of stenothermic species. Although bottom temperature minima of the four inner benthic stations were several degrees cooler on the northern transect than on the southern transect (Joyce and Williams, 1969), two of

TABLE 17. BATHYMETRIC AND INTERTRANSECT DISTRIBUTIONS OF THE GAMBARELLOIDES SPECIES OF *Synalpheus* CAPTURED DURING NIGHTTIME HOURGLASS SAMPLING; 45-FT TRAWL CATCHES OMITTED.

	North:South	Abundances Depth (m) 6	18	37	55	73
S. longicarpus	29:91	--	49	69	2	--
S. brooksi	63:272	--	15	307	11	2
S. pectiniger	2:2	--	--	4	--	--
S. bousfieldi	1:2	--	--	1	2	--
S. pandionis	63:527	5	41	30	342	172
S. goodei	15:46	--	16	3	12	30
S. herricki	15:31	1	--	12	10	23
S. paraneptunus	0:3	--	--	--	--	3
Total	188:974	6	121	426	379	230

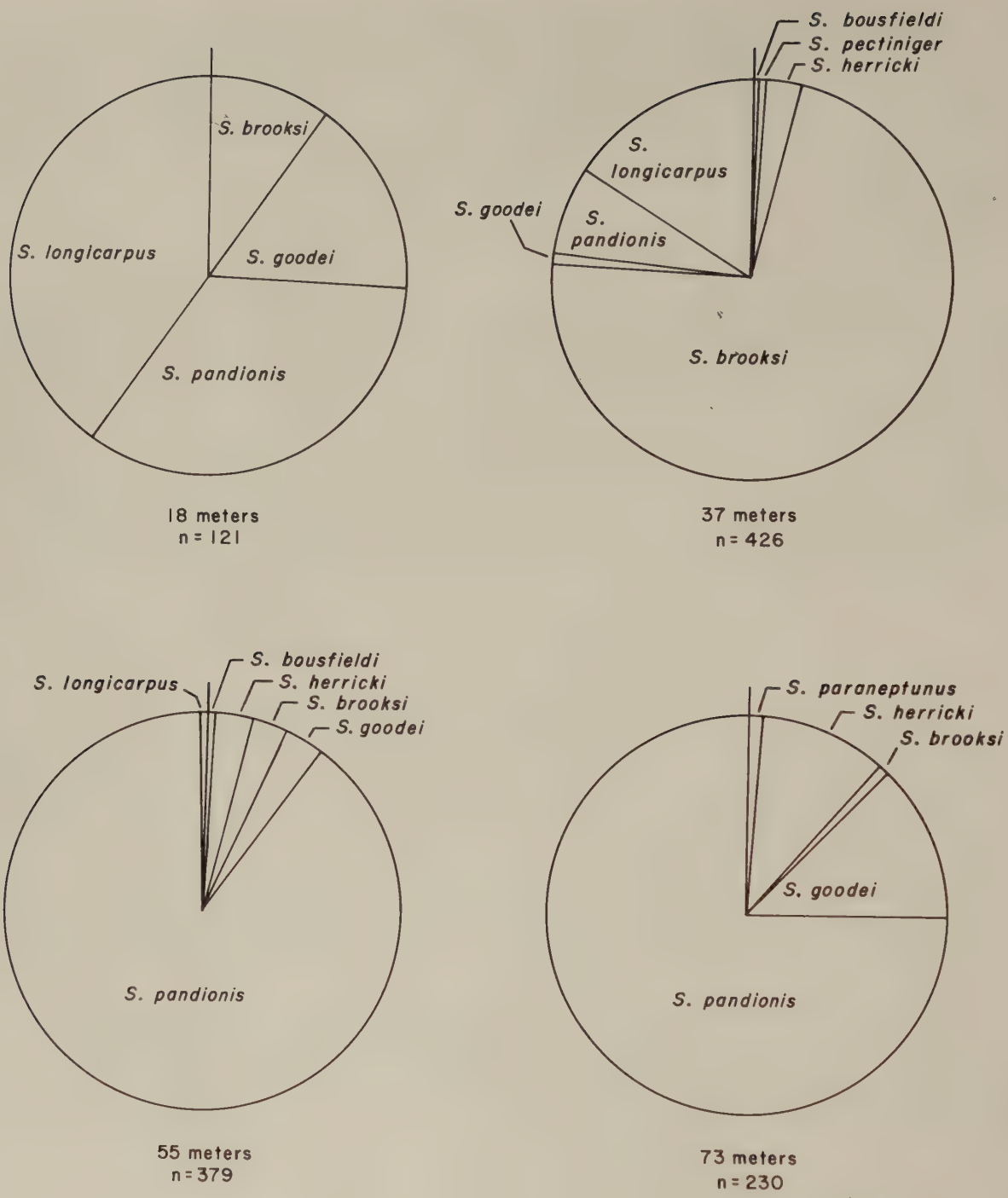

Figure 54. Interspecific relative dominance by depth of Hourglass Gambarelloides species of *Synalpheus*.

the most abundant species, *S. brooksi* and *S. longicarpus*, were collected from temperatures as low as 13.9°C, the lowest bottom temperature recorded at any of the four outermost stations on either transect. The greater abundance of species on the southern transect, however, still may represent larger populations encouraged by more favorable water temperatures, but it seems more likely that microhabitat preferences are responsible for different species abundances on the two transects.

The eight species collected during the Hourglass Cruises were ranked according to percent relative abundance of each species at each of the four outermost station pairs, located at depths of 18, 37, 55, and 73 m (Figure 54). Only six individuals of two species were collected from the 6 m stations (Table 17). At the 18 m stations (B/J), two species, *S. longicarpus* and *S. pandionis*, were most abundant. As noted in the species account, however, the dominance of *S. longicarpus* is based on only three successful collections at Station J (Table 7), whereas *S. pandionis* was collected more frequently at this station (Table 9), albeit in fewer numbers. *Synalpheus longicarpus* occurred far more frequently at 37 m stations (C/K), but is overshadowed there by *S. brooksi*, which clearly predominates both numerically and in frequency of capture (Table 3). The abundance of these common inhabitants of loggerhead sponges is probably linked to the occurrence of the sponge host at these stations (Joyce and Williams, 1969). Although both stations at this depth were numerically dominated by *S. brooksi*, seven of the eight Hourglass species were collected from 37 m. Six Gambarelloides species of *Synalpheus* were collected from the 55 m stations (D/L), but over 90% of the individuals were *S. pandionis*. Likewise, *S. pandionis* accounted for 75% of the individuals among the five species present at the 73 m stations (E/M). However, *S. pandionis* occurred in markedly greater numbers and frequencies at southern stations of both depths (Table 9).

Synalpheus pandionis was the most eurybathic species collected; it was the only one taken at all five depths. *Synalpheus paraneptunus* was found only at the outermost southern station, while *S. pectiniger* was found only at the 37 m stations. The three specimens of *S. bousfieldi* collected from the Hourglass stations were restricted to the 37 and 55 m stations. *Synalpheus goodei* was taken in small numbers at all four offshore depths, and *S. herricki* was taken in similar abundances at 37-73 m but was absent at 18 m and represented by a single specimen at 6 m. Each species accounted for at least 10% of the Gambarelloides population at 73 m depths, and *S. goodei* also accounted for more than 10% at 18 m depths. Interestingly, *S. goodei* was more abundant at the 18 m station on the northern transect but was more abundant at the 73 m station on the southern transect (Figure 22). Both species constituted minor portions of Gambarelloides populations at 37 and 55 m depths because of the greater numbers of species and the numerical dominance of *S. brooksi* and *S. pandionis* in those depths (Figure 54).

Understanding of species associations within the Hourglass study area will be greatly strengthened when data for the non-Gambarelloides species of *Synalpheus*, as well as for other carideans, are available.

LITERATURE CITED

ABELE, L. G.

1970. The marine decapod Crustacea of the northeastern Gulf of Mexico. M.S. Thesis. Florida State University, Tallahassee, Florida. 137 pp.

1975. The macruran decapod Crustacea of Malpelo Island. Pp. 69-85 *in* J. B. Graham (ed.). The Biological Investigation of Malpelo Island, Colombia. Smithson. Contrib. Zool. No. 176.

1976. Comparative species composition and relative abundance of decapod crustaceans in marine habitats of Panamá. Mar. Biol. 38: 263-275.

1979. The community structure of coral-associated decapod crustaceans in variable environments. Pp. 265-287 *in* R. J. Livingston (ed.). Ecological Processes in Coastal and Marine Systems. Plenum Press, N.Y.

ABELE, L. G., and W. K. PATTON

1976. The size of coral heads and the community biology of associated decapod crustaceans. J. Biogeogr. 3: 35-47.

ARMSTRONG, J. C.

1949. New Caridea from the Dominican Republic. Amer. Mus. Novitates 1410: 1-27.

ARNDT, W.

1933. Die biologischen Beziehungen zwischen Schwammen und Krebsen. Mit. Zool. Mus. Berlin 19: 221-305.

BACCI, G.

1965. Sex Determination. Pergamon Press, N.Y. 306 pp.

BANNER, A. H.

1953. The Crangonidae, or snapping shrimp, of Hawaii. Pac. Sci. 7: 3-144.

1956. Contributions to the knowledge of the alpheid shrimp of the Pacific Ocean. Part I. Collections from the Mariana Archipelago. Pac. Sci. 10: 318-373.

BANNER, A. H., and D. M. BANNER

1966. The alpheid shrimp of Thailand. Siam Soc., Monogr. No. 3: 1-168.

BANNER, D. M., and A. H. BANNER

1975. The alpheid shrimp of Australia. Part 2: The genus *Synalpheus*. Rec. Aust. Mus. 29: 267-389.

BATE, C. S.

1888. Report on the Crustacea Macrura collected by H.M.S. "Challenger" during the years 1873-1876. Rep. Sci. Results Voyage H.M.S. "Challenger" 24: 1-942.

BAUER, R. T.

1976. Mating behaviour and spermatophore transfer in the shrimp *Heptacarpus pictus* (Stimpson) (Decapoda: Caridea: Hippolytidae). J. Nat. Hist. 10: 415-440.

BOONE, L.
1930. Scientific results of the cruises of the yachts "Eagle" and "Ara", 1921-1928, William K. Vanderbilt, Commanding. Crustacea: Stomatopoda and Brachyura. Bull. Vanderbilt Mar. Mus. 2: 1-228.

BRIGGS, J. C.
1974. Marine Zoogeography. McGraw-Hill, N.Y. 475 pp.

BRIGHT, T. J., and L. H. PEQUEGNAT
1974. Biota of the West Flower Garden Bank. Gulf Publ. Co., Houston, Texas. 435 pp.

BRUCE, A. J.
1972. Notes on some Indo-Pacific Pontoniinae, XVIII. A redescription of *Pontonia minuta* Baker, 1907, and the occurrence of abbreviated development in the Pontoniinae (Decapoda Natantia, Palaemonidae). Crustaceana 23(1): 65-75.
1976a. Coral reef Caridea and "commensalism". Micronesica 12(1): 83-98.
1976b. Shrimps and prawns of coral reefs, with special reference to commensalism. Pp. 37-94 *in* O. A. Jones and R. Endean (eds.). Biology and Geology of Coral Reefs, Vol. III: Biology 2. Academic Press, N.Y.

CERAME-VIVAS, M. J., and I. E. GRAY
1966. The distributional pattern of benthic invertebrates of the continental shelf off North Carolina. Ecology 47(2): 260-270.

CHACE, F. A., JR.
1937a. Appendix I, Summaries of the work of visiting scientists. Pp. 55-57 *in* The Bermuda Biological Station for Research, Reports of Officers for the Years 1935 and 1936.
1937b. Caridean decapod Crustacea from the Gulf of California and the west coast of Lower California. The Templeton Crocker Expedition. Part VII. Zoologica 22(8): 109-138.
1956a. Crustaceos decapodos y stomatopodos del Archipielago de Los Roques e Isla de La Orchila. Pp. 145-168 *in* El Archipielago Los Roques y La Orchila. Soc. Cienc. Nat. Inst. La Salle.
1956b. Pp. 5-23 *in* S. Springer and H. Bullis (eds.). Collections by the *Oregon* in the Gulf of Mexico. U.S. Bur. Comm. Fish., Spec. Sci. Rep., Fish., No. 196.
1972. The shrimps of the Smithsonian-Bredin Caribbean Expeditions, with a summary of the West Indian shallow-water species (Crustacea: Decapoda: Natantia). Smithson. Contrib. Zool. 98: 1-179.

CHARNIAUX-COTTON, H.
1965. Hormonal control of sex differentiation in invertebrates. Pp. 701-740 *in* R. L. DeHaan and H. Ursprung (eds.). Organogenesis. Holt, N.Y.

CHRISTOFFERSEN, M. L.
1979. Campagne de la *Calypso* au large des côtes Atlantiques de l'Amérique du sud (1961-1962). I. Decapod Crustacea: Alpheoida. Résult. Scient. Camp. *Calypso* 11: 297-377.

COELHO, P. A., and M. D. A. RAMOS
1972. A constituição e a distribuição da fauna de decápodos do litoral leste da América do sul entre as latitudes de 5° N e 39° S. Trabhs. Oceangr. Univ. Fed. Pe. Recife 13: 133-236.

COLLARD, S. B., and C. N. D'ASARO
1973. Benthic invertebrates of the eastern Gulf of Mexico. Pp. IIIG1-28 *in* J. I. Jones et al. (eds.). A Summary of Knowledge of the Eastern Gulf of Mexico. State Univ. System of Florida, Inst. Oceanogr., St. Petersburg.

CORRÊA, M. M. G.
1972. Contribuição ao conhecimento da fauna do Arquipélago de Abrolhos, Bahia, Brasil. 2. Lista preliminar dos crustáceos decápodos. Bol. Mus. Hist. Nat. Univ. F. Minas Gerais, Zool. 15: 1-19.

COUTIÈRE, H.
1898. Sur quelques variétés de *Synalpheus laevimanus* Heller (Crust.). Bull. Soc. Ent. Fr. (1898): 188-191.
1899. Les "Alpheidae," morphologie externe et interne, formes larvaires, bionomie. Ann. Sci. Nat., Zool. 9: 1-559.
1900. Sur quelques Alpheidae des côtes americaines (Collection de l'U.S. National Museum, Washington). C. R. Hebd. Séanc. Acad. Sci., Paris, 131: 356-358.
1907. Sur la presence de males en exces chez deux especes de synalphees. C. R. Séanc. Soc. Biol. 62: 610-612.
1908. Sur les synalphees americaines. C. R. Hebd. Séanc. Acad. Sci., Paris, 146: 710-712.
1909. The American species of snapping shrimps of the genus *Synalpheus*. Proc. U.S. Natl. Mus. 36: 1-93.
1910. The snapping shrimps (Alpheidae) of the Dry Tortugas, Florida. Proc. U.S. Natl. Mus. 37: 485-487.

CROIZAT, L., G. NELSON, and D. E. ROSEN
1974. Centers of origin and related concepts. Syst. Zool. 23: 265-287.

DARWIN, C.
1872. The Origin of Species. Sixth Edition, reprinted by Macmillan Publ. Co., Inc. 1962. 512 pp.

DAVENPORT, D.
1955. Specificity and behavior in symbioses. Quart. Rev. Biol. 30(1): 29-46.

DE LAUBENFELS, M. W.
1936. A discussion of the sponge fauna of the Dry Tortugas in particular, and the West Indies in general, with material for a revision of the families and orders of the Porifera. Pap. Tortugas Lab., Carnegie Inst. Wash. 30: 1-225.

DOBKIN, S.
1965. The first post-embryonic stage of *Synalpheus brooksi* Coutière. Bull. Mar. Sci. Gulf Caribb. 15: 450-462.

1969. Abbreviated larval development in caridean shrimps and its significance in the artificial culture of these animals. FAO Fisheries Rep. 57: 935-945.

FAUSTO-FILHO, J., and J. B. S. SAMPAIO NETO
1976. Observaçöes sobre alguns crustáceos estomatópodos e decápodos do norte do Brasil. Arq. Ciên. Mar. 16(2): 65-71.

FELDER, D. L.
1982. Reproduction of the snapping shrimps *Synalpheus fritzmuelleri* and *S. apioceros* (Crustacea: Decapoda: Alpheidae) on a sublittoral reef off Texas. J. Crust. Biol. 2(4): 535-543.

FELDER, D. L., and A. H. CHANEY
1979. Decapod crustacean fauna of Seven and One-half Fathom Reef, Texas: species composition, abundance, and species diversity. Contrib. Mar. Sci. 22: 1-29.

GARTH, J. S.
1975. Decapod crustaceans inhabiting reef-building corals of Ceylon and the Maldive Islands. J. Mar. Biol. Ass. India 15(1): 195-212.

GORE, R. H.
1981. Three new shrimps, and some interesting new records of decapod Crustacea from a deep-water coral reef in the Florida Keys. Proc. Biol. Soc. Wash. 94(1): 135-162.

GRANT, V.
1977. Organismic Evolution. W. H. Freeman and Co., San Francisco. 418 pp.

GURNEY, R.
1949. The larval stages of the snapping-shrimp, *Synalpheus goodei* Coutière. Proc. Zool. Soc. London 119: 293-295.

HAY, W. P., and C. A. SHORE
1918. The decapod crustaceans of Beaufort, N.C., and the surrounding region. Bull. Bur. Fish. 35: 369-475.

HAZLETT, B. A., and H. E. WINN
1962. Sound production and associated behavior of Bermuda crustaceans (*Panulirus*, *Gonodactylus*, *Alpheus*, and *Synalpheus*). Crustaceana 4: 25-38.

HEARD, R. W., and D. G. PERLMUTTER
1977. Description of *Colomastix janiceae* n. sp., a commensal amphipod (Gammaridea: Colomastigidae) from the Florida Keys, USA. Proc. Biol. Soc. Wash. 90(1): 30-42.

HECK, K. L., JR.
1977. Comparative species richness, composition, and abundance of invertebrates in Caribbean seagrass (*Thalassia testudinum*) meadows (Panamá). Mar. Biol. 41: 335-348.

HERRICK, F. H.
1891. *Alpheus*: A study in the development of Crustacea. Mem. Natl. Acad. Sci. 5: 370-463.

HOLTHUIS, L. B.
1959. The Crustacea Decapoda of Suriname (Dutch Guiana). Zool. Verh. Rijksmus. Nat. Hist., Leiden, 44: 1-296.

HOLTHUIS, L. B., and E. GOTTLIEB
1958. An annotated list of the decapod Crustacea of the Mediterranean coast of Israel, with an appendix listing the Decapoda of the eastern Mediterranean. Bull. Res. Council Israel 7B(1-2): 1-126.

HOPKINS, T. S., D. R. BLIZZARD, S. A. BRAWLEY, S. A. EARLE, D. E. GRIMM, D. K. GILBERT, P. G. JOHNSON, E. H. LIVINGSTON, C. H. LUTZ, J. K. SHAW, and B. B. SHAW
1977. A preliminary characterization of the biotic components of composite strip transects on the Florida Middle Grounds, northeastern Gulf of Mexico. Proc. 3rd Internatl. Coral Reef Symp., Miami, 1: 31-37.

HOPKINS, T. S., D. R. BLIZZARD, and D. K. GILBERT
1977. The molluscan fauna of the Florida Middle Grounds with comments on it's [sic] zoogeographic affinities. Northeast Gulf Sci. 1(1): 39-47.

JOYCE, E. A., JR., and J. WILLIAMS
1969. Rationale and pertinent data. Mem. Hourglass Cruises 1(1): 50 pp.

LYONS, W. G., S. P. COBB, D. K. CAMP, J. A. MOUNTAIN, T. SAVAGE, L. LYONS, and E. A. JOYCE, JR.
1971. Preliminary inventory of marine invertebrates collected near the electrical generating plant, Crystal River, Florida, in 1969. Fla. Dep. Nat. Resour. Mar. Res. Lab., Prof. Pap. Ser. No. 14: 1-45.

MARKHAM, J. C., and J. J. McDERMOTT
1981. A tabulation of the Crustacea Decapoda of Bermuda. Proc. Biol. Soc. Wash. 93(4): 1266-1276.

McCLENDON, J. F.
1911. On adaptations in structure and habits of some marine animals of the Tortugas, Florida. Pap. Tortugas Lab., Carnegie Inst. Wash. 3: 57-62.

McCLOSKEY, L. R.
1970. The dynamics of the community associated with a marine scleractinian coral. Int. Revue Ges. Hydrobiol. 55(1): 13-81.

McLAUGHLIN, P. A.
1980. Comparative Morphology of Recent Crustacea. W. H. Freeman and Co., San Francisco. 177 pp.

MENZEL, R. W., ed.
1971. Checklist of the marine fauna and flora of the Apalachee Bay and the St. George's Sound area. 3rd ed. Fla. State Univ. Oceanogr. Inst. 126 pp.

MONOD, T.
1939. Sur quelques Crustacés de la Guadeloupe (Mission P. Allorge, 1936). Bull. Mus. Hist. Nat., Paris, (2)11: 557-568.

NOUVEL, H., and L. NOUVEL
1937. Recherches sur l'accouplement et la ponte chez les Crustacés Décapodes Natantia. Bull. Soc. Zool. Fr. 62: 208-221.

PEARSE, A. S.
1932a. Observations on the parasites and commensals found associated with crustaceans and fishes at Dry Tortugas, Florida. Pap. Tortugas Lab., Carnegie Inst. Wash. 28: 103-115.
1932b. Inhabitants of certain sponges at Dry Tortugas. Pap. Tortugas Lab., Carnegie Inst. Wash. 28: 119-122.
1950. Notes on the inhabitants of certain sponges at Bimini. Ecology 31(1): 149-151.

PEARSE, A. S., and L. G. WILLIAMS
1951. The biota of the reefs off the Carolinas. J. Elisha Mitchell Scient. Soc. 67: 133-161.

PEQUEGNAT, L. H., and R. W. HEARD
1979. *Synalpheus agelas*, new species of snapping shrimp from the Gulf of Mexico and Bahama Islands (Decapoda: Caridea: Alpheidae). Bull. Mar. Sci. 29(1): 110-116.

PEQUEGNAT, L. H., and J. P. RAY
1974. Crustacea and other arthropods. Pp. 232-261 *in* T. J. Bright and L. H. Pequegnat (eds.). Biota of the West Flower Garden Bank. Gulf Publ. Co., Houston, Texas.

RATHBUN, M. J.
1901. The Brachyura and Macrura of Porto Rico. Bull. U.S. Fish. Comm. 20: 1-127.

RAY, J. P.
1974. A study of the coral reef crustaceans (Decapoda and Stomatopoda) of two Gulf of Mexico reef systems: West Flower Garden, Texas and Isla de Lobos, Veracruz, Mexico. Ph.D. Dissertation. Texas A&M Univ., College Station, Texas. 323 pp.

REED, J. K., R. H. GORE, L. E. SCOTTO, and K. A. WILSON
1982. Studies on decapod Crustacea from the Indian River region of Florida, XXIV. Community composition, structure, areal and trophic relationships of decapods associated with shallow- and deep-water *Oculina varicosa* coral reefs. Bull. Mar. Sci. 32(3): 761-786.

RODRIGUEZ, G.
1980. Los Crustaceos Decapodos de Venezuela. Instituto Venezolano de Investigaciones Cientificas, Caracas. 494 pp.

ROSEN, D. E.
1975. A vicariance model of Caribbean biogeography. Syst. Zool. 24(4): 431-464.

ROUSE, W. L.
1970. Littoral Crustacea from southwest Florida. Quart. J. Fla. Acad. Sci. 32(2): 127-152.

SCHMITT, W. L.
1924a. The macruran, anomuran and stomatopod Crustacea. Bijdragen Tot de Kennis der Fauna van Curaçao. Resultaten Eener Reis van Dr. C. J. van der Horst in 1920. Bijdr. Dierk. 23: 61-81.
1924b. Report on the Macrura, Anomura and Stomatopoda collected by the Barbados-Antigua Expedition from the University of Iowa in 1918. Stud. Nat. Hist., Iowa Univ., 10(4): 65-99.
1930. Some observations on the Crustacea of Tortugas, Florida. Yearbook Carnegie Inst. Wash. 29: 343-346.
1933. Four new species of decapod crustaceans from Porto Rico. Amer. Mus. Novitates 662: 1-9.
1935. Crustacea Macrura and Anomura of Porto Rico and the Virgin Islands. N.Y. Acad. Sci., Scient. Surv. P. Rico 15(a): 125-227.
1936. Macruran and anomuran Crustacea from Bonaire, Curaçao and Aruba. Zoologische ergebnisse einer reise nach Bonaire, Curaçao und Aruba im Jahre 1930. Number 16. Zool. Jb., Syst. 67: 363-378.
1939. Decapod and other Crustacea collected on the Presidential Cruise of 1938 (with introduction and station data). Smithson. Misc. Coll. 98(6): 1-29.

SOTO, L. A.
1972. Decapod shelf-fauna of the northeastern Gulf of Mexico. Distribution and zoogeography. M.S. Thesis. Florida State University, Tallahassee, Florida. 128 pp.

SPIVEY, H. R.
1981. Origins, distribution, and zoogeographic affinities of the Cirripedia (Crustacea) of the Gulf of Mexico. J. Biogeogr. 8: 153-176.

STEBBING, T. R. R.
1915. South African Crustacea. (Part VIII *in* S. A. Crustacea, for the Marine Investigations in South Africa). Ann. S. Afr. Mus. 15(2): 57-104.

TABB, D. C., and R. B. MANNING
1961. A checklist of the flora and fauna of northern Florida Bay and adjacent brackish waters of the Florida mainland collected during the period July, 1957 through September, 1960. Bull. Mar. Sci. Gulf Caribb. 11(4): 552-649.

UEBELACKER, J. M.
1977. Cryptofaunal species/area relationship in the coral reef sponge, *Gelliodes digitalis*. Proc. 3rd Internatl. Coral Reef Symp., Miami, 1: 69-74.

VERRILL, A. E.
1900. Additions to the Crustacea and Pycnogonida of the Bermudas. Trans. Conn. Acad. Arts Sci. 10: 573-582.
1922. Decapod Crustacea of Bermuda, Pt. II. Macrura. Trans. Conn. Acad. Arts Sci. 26: 1-179.

WASS, M. L.
1955. The decapod crustaceans of Alligator Harbor and adjacent inshore areas of northwestern Florida. Quart. J. Fla. Acad. Sci. 18(3): 129-176.

WESTINGA, E., and P. C. HOETJES
1981. The intrasponge fauna of *Spheciospongia vesparia* (Porifera, Demospongiae) at Curaçao and Bonaire. Mar. Biol. 62: 139-150.

WILLIAMS, A. B.
1965. Marine decapod crustaceans of the Carolinas. U.S. Fish Wildl. Serv., Fish. Bull. 65(1): 1-298.

WILLIAMS, G. C.
1975. Sex and Evolution. Princeton Univ. Press, Princeton, N.J. 200 pp.

YOUNG, A. M.
1978. Superorder Eucarida, order Decapoda. Pp. 171-185 *in* R. G. Zingmark (ed.). An annotated checklist of the biota of the coastal zone of South Carolina. Univ. of South Carolina Press, Columbia. 364 pp.

ZIMMER, C.
1913. Westindische Decapoden, 1: Die Familie Alpheidae. Zool. Jb., Suppl. 11(3): 381-412.